Vol 2 of 3

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U.S. Army Environmental Center

Phase II Site Investigations Report
Volume II of III
Site-Specific Investigations
Fort Devens Sudbury Training Annex, Massachusetts

September 1994
Contract No. DAAA15-90-D-0012
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Prepared for:
Commander
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Aberdeen Proving Ground, Maryland 21010-5401

Prepared by:
ecology and environment, inc.
1700 North Moore Street
Arlington, Virginia 22209

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PHASE II SITE INVESTIGATIONS
FORT DEVENS SUDBURY TRAINING ANNEX
MAYNARD, MASSACHUSETTS

VOLUME II OF III
SITE INVESTIGATIONS BY WATERSHED

Contract No. DAAA15-90-D-0012
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Ecology and Environment, Inc.
Arlington, Virginia 22209

Nermin K. Ahmad
E & E Report Coordinator

Lewis A. Welzel
E & E Program Manager

Robert J. King
E & E Project Manager

PREFACE

This is Volume II of a three volume set that comprises the report of the site-specific investigations (SIs) conducted at the Sudbury Training Annex of Fort Devens, Massachusetts. To evaluate each site, the Annex has been divided into seven distinct watersheds. This volume provides findings of the field effort for each watershed as a shole and for each site.

Volume III of this report set includes the appendices which consist of field reports, special studies, and QA/QC results.

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LIST OF ACRONYMS

AEHA	U.S. Army Environmental Hygiene Agency
AMSL	Above Mean Sea Level
ARARs	Applicable or Relevant and Appropriate Requirements
ARIEM	Army Research Institute of Environmental Medicine
BGS	Below ground surface
BNAs	Base/neutral/acid extractables
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFHA	Capehart Family Housing Area
CLP	Contract Laboratory Program
CWA	Clean Water Act
cm/sec	Centimeters per second
DDD	dichlorodiphenyldichloroethane
DDT	dichlorodiphenyltrichloroethane
DEC	Digital Equipment Corporation
DERP	Defense Environmental Restoration Program
DoD	U.S. Department of Defense
DQOs	Data Quality Objectives
E & E	Ecology and Environment, Inc.
EM	Electromagnetics
EPA	U.S. Environmental Protection Agency
EMO	Environmental Management Office (Fort Devens)
FEL	Food Experiment Laboratories (Natick Laboratories)
FEMA	Federal Emergency Management Agency
FIT	Field Investigation Team
FORSCOM	U.S. Army Forces Command
FS	Feasibility Study
gpm	Gallons per minute
GPR	Ground Penetrating Radar
GW	Groundwater
GZA	Goldberg Zoino and Associates
HEPA	High-efficiency particulate air
IRDMIS	Installation Restoration Data Management Information System
IRP	Installation Restoration Program
LFS	Leupold Forestry Service
MADEQE	Massachusetts Department of Environmental Quality and Engineering
MA/CWA	Massachusetts/Clean Water Act
MA SMCL	Massachusetts Secondary MCL
MBSA	Maynard Back-up Storage Area

MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Level Goals
MCP	Massachusetts Contingency Plan
MDEP	Massachusetts Department of Environmental Protection
MEP	Master Environmental Plan
MMCL	Massachusetts Maximum Contaminant Level
MOTS	Maynard Ordnance Test Station
MREs	Meals Ready to Eat
μg/g	Micrograms per gram
μg/L	Micrograms per liter
NARADCOM	U.S. Army Natick Research and Development Command
NCO	Non-Commissioned Officer
NFA	No Further Action
NFADD	No Further Action Decision Document
NHESP	Natural Heritage and Endangered Species Program (Massachusetts)
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
OHM	OHM Remediation Services Corporation, A Subsidiary of OHM Corporation
OVA	Organic vapor analyzer
PAH	Polynuclear Aromatic Hydrocarbons or Polycyclic Aromatic Hydrocarbons
PARCC	Precision, accuracy, representativeness, capability, and completeness
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene or Perchloroethene
PID	Photoionization Detector
POLs	Petroleum, Oil, or Lubricants
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RAS	Routine Analytical Services
RBA II	Rapid Bioassessment Protocol II
RBC	Risk-Based Concentration
RI	Remedial Investigation
RPD	Relative percent difference
S	Soil
SAS	Special Analytical Services
SED	Sediment
SI	Site Investigation
SM	Scanner Magnetrometric
SMCL	Secondary MCL
SOW	Scope of Work
SQC	Sediment Quality Criteria
SSI	Supplemental Site Investigation
TAL	Target Analyte List
TCL	Target Compound List
TEPS	Total Environmental Program Support

TOC	Total Organic Carbon
TPHC	Total Petroleum Hydrocarbons
TRC	Technical Review Committee
USAEC	United States Army Environmental Center
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USDA	United States Department of Agriculture
USDOI	United States Department of the Interior
USGS	United States Geological Survey
UST	Underground Storage Tank
UXO	Unexploded ordnance
VOC	Volatile Organic Compound
WQC	Water Quality Criteria

1. WATERSHED 1A — UPPER TAYLOR BROOK

1.1 WATERSHED DESCRIPTION AND ASSESSMENT

Proposed investigative activities for the sites identified at the Sudbury Annex (the Annex) were determined through a review of previous activities and findings, and are governed by the established Scope of Work (SOW). The objectives of the activities were to determine whether any contamination exists in groundwater, surface water, sediment, or surface/subsurface soils at the assigned Phase II sites, and, in the cases where contamination is thought or known to exist, to confirm and better characterize its nature and extent.

To evaluate each site, and to develop a better understanding of the site's impact on the Annex environment, the Annex has been divided into seven distinct watersheds. In this report, general findings of the field effort are first summarized for each watershed as a whole. Detailed information about activities undertaken and sampling results is then provided for each site. Conclusions and recommendations are reviewed and discussed in conjunction with the findings of the Phase I investigation conducted by OHM Remediation Services Corporation (OHM). Data results are presented with each site investigation (SI) section. The methodology used in the screening of analytical results generated through this Phase II SI, and the screening values used to identify areas of possible concern, are fully explained in Section 7, Volume I of this report. The appendices provide field reports, special studies and quality assurance/quality control (QA/QC) results used throughout this report to support the information presented in the text.

The sites in Watershed 1A — Upper Taylor Brook, are shown in Figure 1-1. For ease of reference, Table 1-1 identifies each site in the watershed by number, name, and status with respect to ongoing investigation activities.

Table 1-1

WATERSHED 1A SITES

Site Number	Site Name	Current Status
P6	Puffer Pond Possible Dump Area	Site Investigation
P16	Chemical and Waste Storage Bunkers 302, 306, and 309	Site Investigation
P27	Pyrotechnics Test Area	Site Investigation
P41	Bunker 303 Pesticide/Herbicide Storage	Site Investigation
P43A/B	Disturbed Area/Stained Soils and Stressed Vegetation	Site Investigation
P52	Possible Dump Near FEMA Property	Site Investigation
P54	Additional Bunkers 305, 307, and 314	Site Investigation
P56	Cleared Area South of Bunker 313	Site Investigation

Source: Ecology and Environment, Inc. 1994.

1.1.1 Watershed Location and Description

Taylor Brook is a short (about 2 miles long) tributary of the Assabet River. It flows generally from southeast to northwest, and its watershed of 3 to 4 square miles has been subdivided into Watershed 1A — Upper Taylor Brook, and Watershed 1B — Lower Taylor Brook.

Watershed 1A encompasses the area drained by Taylor Brook above (that is, southeast of) its junction with Honey Brook. The catchment area extends beyond facility boundaries and includes Cutting and Vose Ponds, Taylor Brook to its source, and areas north of the Annex adjacent to the Town of Maynard's land (formerly part of the Annex).

Watershed 1A includes two bunker areas: the first, a cluster of 21 bunkers in the area west of Puffer Pond (Bunkers 301 to 321); and the second, a cluster of nine bunkers west of a wetland area and east of the watershed boundary (Bunkers 322 to 328, 330 and 332). Three bunker sites, P16 (Chemical and Waste Storage Bunkers 302, 306, and 309), P41 (Bunker 303 Pesticide/Herbicide Storage), and P54 (Bunkers 305, 307, and 314 where chemical storage or dumping may have occurred) have been identified in Watershed 1A, through interviews and historical research conducted as part of the development of the Master Environmental Plan (MEP).

This watershed's boundaries lie along the crests of four hills of glacial till including three ground moraines to the north, west, and south, and a drumlin to the northeast. A broad, flat valley of glacial outwash separates these four topographic highs. Taylor Brook and Puffer Pond bisect the watershed along a path running from north to south. The southern watershed boundaries lie in a very flat wetland area. Surface runoff flows from the hills (or watershed divides) onto a glacial outwash plain where low topographic gradients have resulted in the creation of extensive wetlands. Surface water flows slowly through these areas to Taylor Brook, and through Watershed 1B to the Assabet River.

In areas of particularly flat topography, especially in the wetland along the southeast watershed boundary, the direction of surface water flow may vary between different rainfall events. The watershed boundary may vary with the elevation of surface water on each side of the normal divide, thereby altering the tributary area of Watershed 1A. Boundaries were plotted on Plate 2 based on Ecology and Environment, Inc., (E & E) observations that took place during field activities from March through December 1993, and on staff gauge measurements collected in September and December 1993.

Groundwater flow follows the slopes of the glacial hills then discharges to the centrally located wetlands. Groundwater is less than 20 feet below ground surface (BGS) throughout almost all of the watershed, except under the highest parts of the hills. Generalized groundwater flow and site-specific flow directions were determined from field observations of topography, drainage, and static water level measurements collected during two rounds of sampling (13 September and 3 December 1993). All groundwater level measurements at Watershed 1A are recorded in Table 1-2. Average groundwater elevations presented in the

SITE NUMBER	SITE NAME
	WATERSHED 1A E&E SITES
P6	PUFFER POND POSSIBLE DUMP AREA
P16	CHEMICAL AND WASTE STORAGE BUNKERS 302, 306, AND 309
P27	PYROTECHNICS TEST AREA
P41	BUNKER 303 PESTICIDE/HERBICIDE STORAGE
P43A/B	DISTURBED AREA/STAINED SOILS AND STRESSED VEGETATION
P52	POSSIBLE DUMP AREA NEAR FEMA PROPERTY
P54	ADDITIONAL BUNKERS 305, 307, AND 314
P56	CLEARED AREA SOUTH OF BUNKER 313

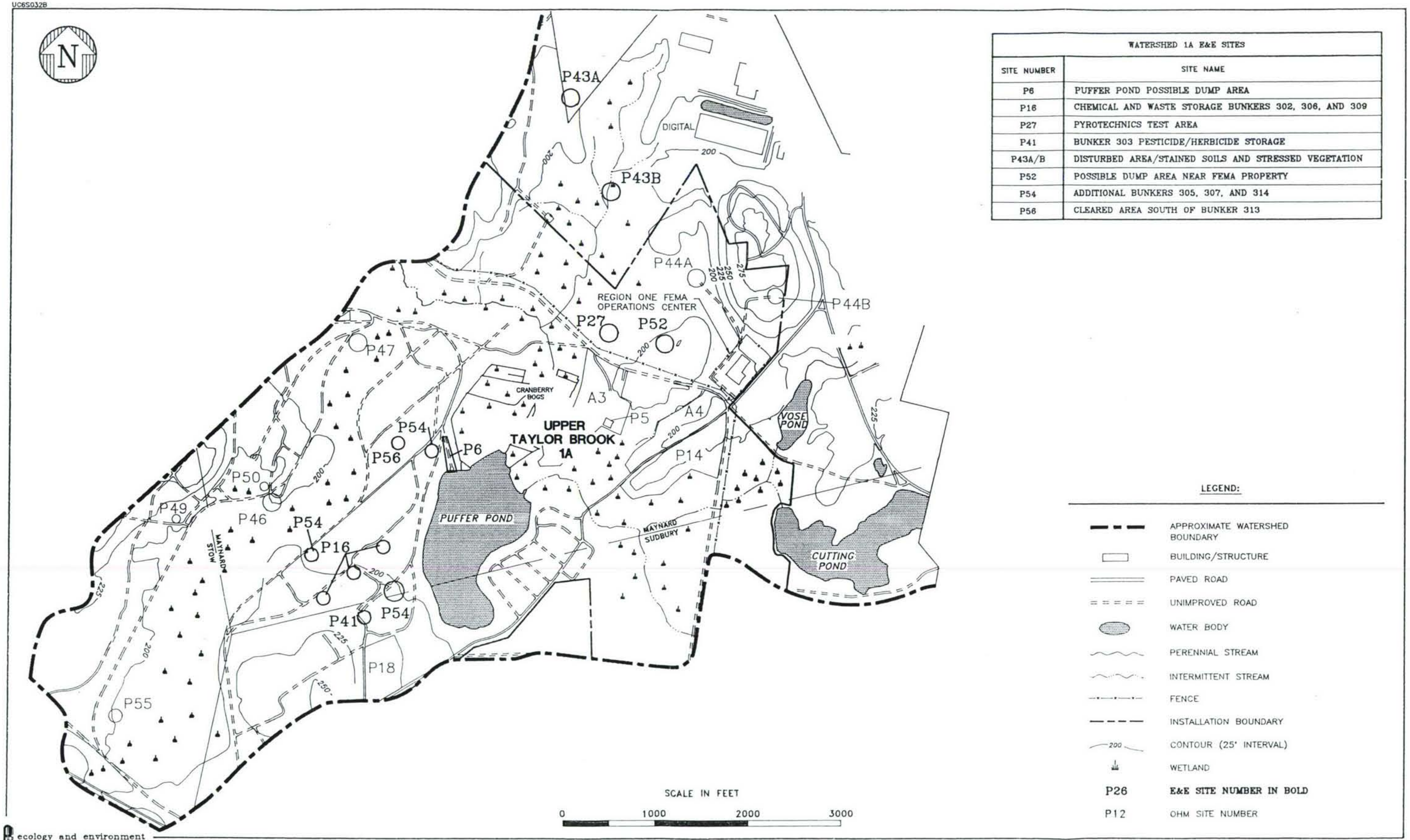


Figure 1-1 WATERSHED 1A – UPPER TAYLOR BROOK

Table 1-2

WATERSHED 1A — UPPER TAYLOR BROOK
WATER LEVEL MEASUREMENTS*

Site	Well	Water Levels**	
		09/13/93	12/03/93
A3	OHM-A3-1	181.49	182.34
	OHM-A3-3	181.89	182.65
	EHA6	182.05	186.50
A4	OHM-A4-4	188.83	191.16
	OHM-A4-5	182.09	183.10
	DM-4	184.69	186.66
	DM-5	189.23	191.87
	EHA7	193.20	194.34
P6	OHM-P06-25	182.42	182.34
	OHM-P06-26	182.03	182.19
	OHM-P06-27	182.82	182.70
P43B	GZA-MW1	196.53	198.83
	GZA-MW2	184.93***	182.99

*Includes data collected from OHM, Dames and Moore, Army Environmental Hygiene Agency (AEHA), and Goldberg Zoino and Associates (GZA) wells.
**All measurements are recorded in feet above mean sea level (AMSL).
***Measured by OHM on June 15, 1992.
Source: Ecology and Environment, Inc. 1994

physical characteristics descriptions for each site incorporate all static groundwater level measurements collected during both rounds of sampling.

The hydrogeology has three stratigraphic layers in Watershed 1A: bedrock, glacial till, and glacial outwash. The slightly weathered bedrock is metamorphic and igneous rock and contains water in limited quantities within fractures. As a result, well yields are low. The till is a mixture of fragments ranging widely in size from cobbles and boulders to clay and is of low hydraulic conductivity with few connected openings for water movement. The outwash is the most transmissive aquifer and usually consists of sands or gravels at the surface. Ice contact and proglacial deposits "stream deposits, which are fine to coarse textured and well stratified in most places, and form the upper twenty to thirty feet of outwash" are uppermost. Below the deposits are a "lower zone composed chiefly of beds of gray, very fine sand and silt and some scattered lenses of coarse material. These lower beds

. . . are chiefly lake-bottom deposits." (Perlmutter 1962) "The ice contact deposits were laid down by glacial streams in tunnels or crevices in the ice, forming elongated mounds called eskers, and against the ice or in holes in the ice, forming roughly circular hills called kames. The stratification of the deposits range from poor to good, and the grains range from clay to cobble gravel in size" (Perlmutter 1962). One esker occurs off the Annex towards Maynard in Watershed 1A and there are adjoining kame terrace deposits. This is close to the location of Maynard Town Well No. 3 and Maynard Test Well 14, which have been shown to tap a moderately productive aquifer used as back-up water supply for the Town of Maynard, but producing water with an offensive taste and smell caused by iron and manganese. South of these wells are two other water supply wells at Puffer Pond (neither of which is currently used as a drinking water source) designated Civil Defense Wells 1 and 2, now the property of the Federal Emergency Management Agency (FEMA), with a capacity of 400 gallons per minute (gpm) each. This implies the presence of a thick (greater than 50 feet) and moderately transmissive aquifer. Both wells are 24 inches in diameter and depths are unknown.

The sites to be investigated in Watershed 1A during Phase II include Site P27, Site P43A, Site P43B, and Site P52 east of Taylor Brook (Site P43A and Site P43B are both now outside the Annex property boundary), and Site P6, Site P16, Site P41, Site P54, and Site P56 west of Taylor Brook and Puffer Pond. Puffer Pond is important to the watershed description both because it receives discharge of groundwater from under the sites west of it and because bioaccumulation studies conducted there by OHM and E & E led to analysis of sediment, surface water, and fish tissue.

A summary table outlining sampling activities performed by E & E during the Phase II SI effort is provided for each site in the section on field work performed.

1.1.2 Preliminary Watershed-Wide Assessment

In order to assess the overall impacts of the Annex on the surrounding environment, a watershed approach has been adopted. This approach divides the facility into areas draining to particular streams and surface water bodies, by surface runoff (which is minimal at the Annex) and by groundwater flow. Within each watershed, the individual sites are potential sources of contaminants and the surface water and sediments are potential receptors or sinks. Movement of water through the Annex and the discharge of groundwater to surface water transports contaminants from the soil to groundwater and then to surface water and sediments. Sediment layers are often organic-rich with high total organic carbon (TOC) that can adsorb contaminants occurring in groundwater before it reaches surface water. Any persistent toxics present in the groundwater discharge can accumulate in sediments and in stream and pond biota, if the toxics bioaccumulate. The result is that any accumulation of contaminants at a watershed tend to be concentrated in the sediments within surface water and in surface water itself.

Results of sediment and surface water sampling at the Annex may provide the Army with indications of the locations of discharges from specific sites that enter surface water pathways. Samples taken at points where drainages leave the Annex or join a larger stream (Table 1–3), are used in assessing the cumulative impact of a particular watershed. Sampling

Table 1-3

SURFACE WATER/SEDIMENT SAMPLE LOCATIONS IN WATERSHED 1A — UPPER TAYLOR BROOK*

Sample ID	Location
BACKGROUND	
E3-BCK-D01	Tributary to Taylor Brook, downgradient of Digital Equipment Corporation (DEC) parking lot**
E3-BCK-D04	Outflow of Cutting Pond
UPSTREAM OF PUFFER POND	
SW/SED11	Drainage from Cutting Pond, just east of Patrol Road
P14SD1/SW1	Drainage south of P14, upgradient of Puffer Pond
A4SD1/SW1 A4SD2/SW2	Drainage from A4 to Puffer Pond
P5SD1/SW1	South of A3/P5, in wetlands, northeast of Puffer Pond
A4SD3/SW3	A4 drainage to Puffer Pond
PUFFER POND	
FW1SD1 . . . . SD7	Puffer Pond (OHM)
FW1SW1 . . . . SW7	Puffer Pond (OHM)
P6SD4/SW4	Puffer Pond (OHM)
E3-PUF-D01 . . . . D06	Puffer Pond (E & E)
DOWNSTREAM OF PUFFER POND	
P6SD1 . . . . SD3 P6SW1 . . . . SW3	Wetlands east of P6, adjacent to Puffer Pond
FW1SD13/SW13	Outflow from Puffer Pond to Taylor Brook
A3SD1/SW1	Wetlands west of A3
FW1SD12/SW12	Taylor Brook immediately south of dirt road that crosses wetlands
SW/SED5	Taylor Brook, north of dirt road
UPSTREAM OF TAYLOR BROOK	
SW/SED2	Stream to Taylor Brook, west and downgradient of Site P27, north of Patrol Road

*From upstream to downstream.
**Note: E3-BCK-D01 was originally sampled as a surface water and sediment background location. However, subsequent review of its location in the runoff path from the parking lot at DEC and analysis results indicating polynuclear aromatic hydrocarbons (PAHs) in this stream led to a decision to exclude these results from being representative of background conditions. These results are considered in the watershed assessment, since this stream enters Taylor Brook.

Source: Ecology and Environment, Inc. 1994.

results were compared to background pond and stream levels and also to preliminary screening values. Surface water screening values include water quality criteria regarding both human health and aquatic life, while sediment screening values are ecologically oriented.

Surface water and sediment sampling results were also compared to site-specific groundwater and soil sampling results to attempt to identify potential sources of watershed contamination. Sampling results from previous investigations by Dames and Moore in 1984 and 1985, OHM in 1992 and 1993, and E & E in 1993 and 1994 (ongoing) have all been considered in the watershed assessments (Dames and Moore 1990, 1986a; OHM 1994). The number of samples used for analysis of particular contaminants will vary depending on the analyte spectrum for each sample used in this assessment.

1.1.2.1 Background Surface Water and Sediment Conditions

One background surface water and sediment sample (E3-BCK-D04) was taken at the outlet from Cutting Pond that flows westward onto the Annex and ultimately into Puffer Pond. In the surface water sample, arsenic, iron, and lead were found above screening values under the Massachusetts Clean Water Act (MA/CWA) Water Quality Criteria (WQC). At 3.15 micrograms per liter (μg/L), arsenic exceeded the 0.018 μg/L MA/CWA WQC screening value for consumption of water and fish. Iron at 2,770 μg/L and lead at 3.82 μg/L exceeded MA/CWA WQC screening levels for protection of aquatic life of 1,000 μg/L and 3.2 μg/L, respectively. In the sediment sample taken at this point, no metals were found in concentrations above screening values, although aldrin (0.007 μg/g) and total petroleum hydrocarbons (TPHC) (16.6 μg/g) were found above sediment screening values. The metal concentrations found in the surface water probably reflect naturally occurring conditions. The pesticide and petroleum hydrocarbons found in the sediment sample probably reflect general pesticide spraying practices in the Maynard area and runoff from local roads into Cutting Pond.

A second background surface water and sediment sample (E3-BCK-D01) was taken in Watershed 1A at the headwaters of Taylor Brook, southwest of the Digital Equipment Corporation (DEC) facility in Maynard. Analysis of results from this surface water sample indicated elevated concentrations of lead, several polynuclear aromatic hydrocarbons (PAH) compounds, and TPHC in sediments above screening levels. These detections are probably due to runoff from the DEC parking lot, which drains into the stream. The samples taken at this point were not thought to be representative of natural background conditions of streams at the Annex and the results were not used for comparison purposes. The DEC parking lot is approximately 1,600 feet northeast of where this tributary flows under Patrol Road and joins the drainage from Puffer Pond to form Taylor Brook. Given that distance, and the wetland areas located between the DEC facility and Patrol Road, it is unlikely that the DEC runoff is having any impact on Taylor Brook. No PAHs above screening values were found in Taylor Brook downstream of this sample point, except at a point northwest of Site A1, where Taylor Brook flows north under Patrol Road. The analytical results of surface water and sediment sampling at these two background locations are presented in Appendix J.

1.1.2.2 Surface Water and Sediment Sampling Results Upstream of Puffer Pond

The only contaminants found above background and screening levels in the drainages that lead into Puffer Pond were arsenic and copper. Arsenic was found in the drainage west of Site A4 in surface water (up to 7.38 μg/L) and in sediments (up to 36 μg/g). However,

arsenic was not elevated above screening levels in groundwater at Site A4 and only one soil sample at Site A4 contained arsenic at a level slightly above the soil screening level of 30 µg/g (Massachusetts Contingency Plan (MCP) Category GW-1/S-1) indicating that discharge of arsenic to surface water from Site A4 is unlikely to have occurred. See Section 7, Volume I for further explanation of MCP values. Arsenic (7.77 µg/g) was also found in sediments in the drainage from Site P14, but was not found above screening levels in soil samples at Site P14. The only metal other than arsenic found at Site P14 in the drainage sediments was copper (24.3 µg/g).

1.1.2.3 Surface Water and Sediment Results from Puffer Pond

Sampling results from Puffer Pond were evaluated using the same screening criteria used elsewhere at the Annex. However, background levels were based on sampling results from an off-site pond, Ministers Pond, in addition to sampling results from the outflow from Cutting Pond. The analytical results of surface water and sediment sampling at Ministers Pond are presented in Appendix J. Analysis of surface water samples taken at Puffer Pond indicate that several metals and one pesticide are found in concentrations above screening and background levels. Arsenic (up to 2.91 µg/L) was slightly elevated in four out of 14 Puffer Pond water samples above the arsenic in the background pond and above the screening level of 0.018 µg/L (MA/CWA WQC for consumption of water and fish). However, arsenic concentrations in Puffer Pond waters were below the level of arsenic (3.15 µg/L) found in the water exiting the upgradient Cutting Pond. Lead concentrations in six of fourteen Puffer Pond surface water samples (up to 10 µg/L) were above the highest level in the background pond (3.02 µg/L) and the screening value of 3.2 µg/L (MA/CWA WQC for protection of aquatic life). Only three Puffer Pond water samples had levels of lead above that found at the Cutting Pond outlet, which was 3.82 µg/g. Cadmium (3.06 µg/L) was found in one sample above the screening level of 1.1 µg/L (MA/CWA WQC for protection of aquatic life). No mercury was found in Puffer Pond surface water samples above method detection limits. One pesticide, endrin (0.359 µg/L), was found in one sample at a concentration above the screening value of 0.0023 µg/L (MA/CWA WQC for protection of aquatic life).

Sediment samples taken at Puffer Pond were analyzed to show concentrations of arsenic above sediment screening values in 12 out of 14 samples taken. The highest arsenic concentration found in Puffer Pond sediments at sample FW1SD3 was 46 µg/g; this is approximately four times the highest arsenic level in Ministers Pond sediments (9.56 µg/g), and more than 20 times the arsenic level in sediment samples taken at the Cutting Pond outlet. The arsenic concentrations in Puffer Pond sediments exceeded both the ecologically oriented Ontario Ministry of the Environment Ontario (MOE) Lowest Effect Level (LEL) of 6 µg/g and the National Oceanic and Atmospheric Administration (NOAA) Effects-Range Low (ERL) of 33 µg/g, but were all below the NOAA Effects-Range Median (ERM) value of 85 µg/g. Two out of 14 Puffer Pond sediment samples also contained lead (up to 111 µg/g) at levels above background (49.4 µg/g) and above the sediment screening level of 31 µg/g (Ontario MOE LEL). The highest lead level found in Puffer Pond sediments is also slightly above the NOAA ERM value of 110 µg/g.

The only pesticides found in Puffer Pond sediments were the dichlorodiphenyl trichloroethane (DDT) degradation products dichlorodiphenyldichloroethane (DDD), and dichlorodiphenyldichloroethylene (DDE). DDD was found at concentrations below the highest concentrations found in Ministers Pond. DDE (0.160 μg/g) was found in one out of 14 samples at a concentration above background (0.074 μg/g), above the screening value of 0.002 μg/g (NOAA ERL), and also above the NOAA ERM criteria for DDE of 0.015 μg/g. This concentration of DDE was below the New York State Department of Environmental Conservation (NYSDEC) SQC for chronic effects on benthic organisms of 0.349 μg/g (adjusted for the TOC content of 34.9 percent of the sediment sample). Given that the NOAA ERL and ERM criteria are not adjusted for organic content on a site-specific basis, the site-specific SQC criteria is a more appropriate ecological benchmark for use in evaluating sediment results at Puffer Pond.

The key concerns at Puffer Pond are the arsenic and lead found in both surface water and sediments. In particular, the detection of arsenic in almost all the Puffer Pond sediment samples seems to indicate site-related contamination. Arsenic has been found in soils at concentrations above screening values at six bunkers located on the western side of Puffer Pond. Puffer Pond sediments contain a much higher organic content (average TOC of 180,000 μg/g) than sediments in other samples in streams and wetlands in Watershed 1A (average TOC of 61,000 μg/g), indicating a higher likelihood of metals adsorbing onto organic-rich Puffer Pond sediments. The low levels of pesticides found in Puffer Pond may reflect historic pest management practices at the Annex. DDT and its degradation products have been found in soils outside Bunker 303, (Site P16), located on the western side of Puffer Pond, although it is unknown whether the DDT found at this bunker may have migrated toward Puffer Pond.

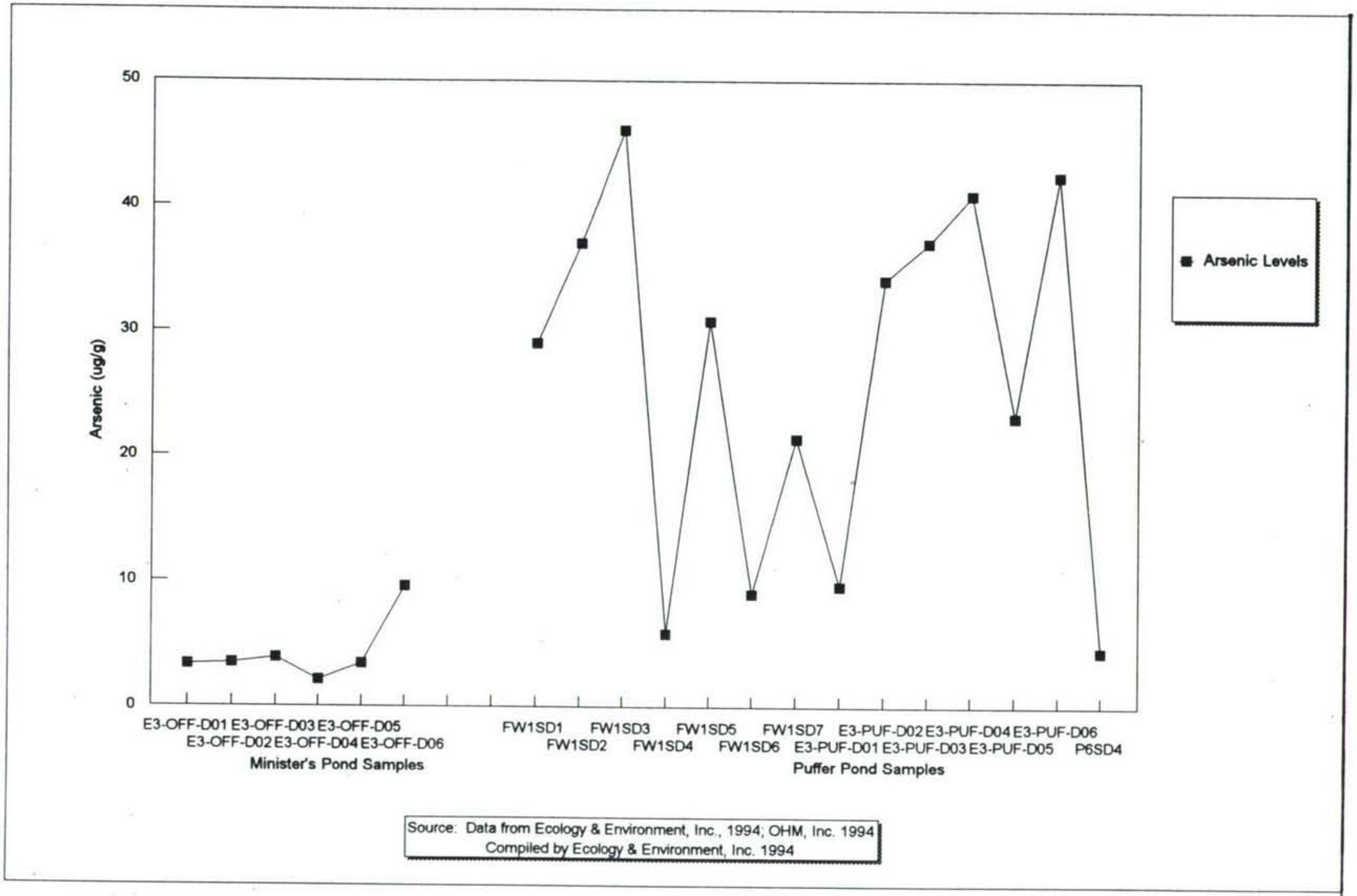
Graph 1–1 provides a comparison of arsenic concentrations in sediments in Ministers Pond and Puffer Pond. Tables 1-4 and 1-5 provide a list of detections above background and screening levels in Puffer Pond surface waters and sediments. The analytical results of E & E surface water and sediment sampling for Puffer Pond are presented in Tables 1-6 and 1-7, Chemical Summary Report for Background Surface Waters and Chemical Summary Report for Sediments, respectively.

Table 1-4

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SURFACE WATERS IN PUFFER POND (μg/L)

Compound	Maximum Back-ground	Screen Level	Source	Highest Concen-tration	Sample ID	Frequency Above Background and Screen Levels
Arsenic	3.15 (stream) <2.0 (pond)	0.018	MA/CWA WQC[1]	2.91	FW1SW7	0/14 (stream background) 4/14 (pond background)
Cadmium	--	1.1	MA/CWA WQC[2]	3.06	E3-PUF-D02	1/14[3]
Lead	3.82 (stream) 3.02 (pond)	3.2	MA/CWA WQC[2]	10	FW1SW4	3/14 (stream background) 6/14 (pond background)
Manganese	156.0 (stream) 26.6 (pond)	--		50.6	P6SW4	0/14 (stream background) 6/14 (pond background)
Endrin	--	0.0023	MA/CWA WQC[2]	0.359	FW1SW1	1/14[3]

[1]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for human consumption of water and fish.
[2]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for protection of aquatic life.
[3]Cadmium and Endrin were not found in background stream or pond samples, thus these exceedances are those above screening levels only.
Source: Ecology and Environment, Inc. 1994.



Graph 1-1 Arsenic Concentrations in Sediments in Ministers and Puffer Ponds

Table 1-5

DETECTIONS ABOVE BACKGROUND AND SCREENING LEVELS IN SEDIMENTS IN PUFFER POND ($\mu g/g$)[1]

Compound	Maximum Background	Screen Level	Source	Highest Concen-tration	Sample ID	Frequency Above Background and Screen Level
Arsenic	9.56	6	Ontario MOE LEL[2]	46	FW1SD3	12/14
Lead	49.4	31	Ontario MOE LEL	111	E3-PUF-D04	2/14
DDE	0.074	0.002	NOAA ERL[3]	0.160	E3-PUF-D03	1/14

[1]Note: The number of samples analyzed changed depending on analyte spectrum by Dames and Moore, OHM, and E & E.
[2]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level
[3]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.

Source: Ecology and Environment, Inc. 1994.

1.1.2.4 Surface Water and Sediment Conditions in Taylor Brook Downstream of Puffer Pond

The areas downstream of Puffer Pond in Watershed 1A include the wetlands north of Puffer Pond and Taylor Brook extending from Puffer Pond to the entrance of Honey Brook. The wetlands north of Puffer Pond include areas that are downgradient of Puffer Pond, Site A3 and Site P6. Thus, detections in these wetlands may reflect sources at one of these sites or in Puffer Pond. In surface water samples from the wetlands and Taylor Brook, arsenic, iron, and lead were found in concentrations above background and screening levels. Arsenic (3.65 $\mu g/L$) was found in one of three surface water samples taken in the wetlands east of P6 at a concentration slightly above the stream background level of 3.15 $\mu g/L$ and the screening level. Arsenic was found in one soil sample at P6 slightly above the soil screening level of 30 $\mu g/g$, but not in filtered groundwater samples, soil borings, or other soil samples, indicating that P6 is probably not a source of arsenic. The highest level of arsenic (9.19 $\mu g/L$) in surface waters in Watershed 1A was found in the wetlands west of Site A3. Arsenic was not found above screening levels in groundwater and soil samples at A3, also indicating that A3 is probably not an arsenic source. Arsenic was not found above background levels in surface water samples taken further downstream in Taylor Brook. Iron (11,000 $\mu g/L$) was found in one sample (P6SW1) in the wetlands east of Site P6 above background and above the screening value of 1,000 $\mu g/L$ (MA/CWA WQC for protection of aquatic life). Manganese (684 $\mu g/L$) was found above background in the same sample. No other contaminants were identified in surface water sampling downstream of Puffer Pond in Watershed 1A at concentrations above background and screening values.

Analysis of sediment samples taken at the outlet of Puffer Pond to Taylor Brook and at the crossing of Puffer Road north of Puffer Pond indicated that arsenic concentrations declined in downstream samples. At the outlet of Puffer Pond to Taylor Brook the arsenic

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 1-6
Chemical Summary Report For Puffer Pond Surface Waters

Units: UGL

	Site ID	E3-PUF-D01	E3-PUF-D02	E3-PUF-D02	E3-PUF-D03	E3-PUF-D04	E3-PUF-D05
	Field Sample ID	WXPUF011	WDPUF021	WXPUF021	WXPUF031	WXPUF041	WXPUF051
	Sample Date	11/05/93	11/05/93	11/05/93	11/05/93	11/05/93	11/05/93
Test	Parameter .						
TAL METAL	Aluminum	40.9	42.8	52.9	49.9	31.4	51.1
	Antimony	< 5.00	< 5.00	1.40 J	< 5.00	< 5.00	< 5.00
	Arsenic	1.83 J@	2.83 @	1.81 J@	2.53 @	1.77 J@	1.84 J@
	Barium	4.39 J	< 10.0	4.93 J	4.57 J	4.15 J	< 10.0
	Cadmium	< 5.00	3.06 J#	< 5.00	< 5.00	< 5.00	< 5.00
	Calcium	3740	3730	3650	3820	3830	3850
	Chromium	2.95 J	3.13 J	< 10.0	< 10.0	< 10.0	< 10.0
	Iron	541	467	460	477	475	484
	Lead	1.55 J	3.25 J#	1.71 J	2.42 J	1.65 J	1.70 J
	Magnesium	907	902	873	917	921	924
	Manganese	18.5	17.7	17.3	17.9	17.5	17.0
	Selenium	1.37 J	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00
	Sodium	5910	6250	6020	6110	5970	6170

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 1-6
Chemical Summary Report For Puffer Pond Surface Waters

Units: UGL

Test	Parameter	E3-PUF-D06					
	Field Sample ID	WXPUF061					
	Sample Date	11/05/93					
TAL METAL	Aluminum	35.1					
	Antimony	< 5.00					
	Arsenic	2.35 @					
	Barium	< 10.0					
	Cadmium	< 5.00					
	Calcium	3770					
	Chromium	< 10.0					
	Iron	452					
	Lead	< 5.00					
	Magnesium	909					
	Manganese	16.8					
	Selenium	< 2.00					
	Sodium	6200					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 1-7
Chemical Summary Report For Puffer Pond Sediments

Units: UGG

Test	Parameter	E3-PUF-D01	E3-PUF-D02	E3-PUF-D02	E3-PUF-D03	E3-PUF-D04	E3-PUF-D05
	Field Sample ID	DXPUF011	DDPUF021	DXPUF021	DXPUF031	DXPUF041	DXPUF051
	Sample Date	11/05/93	11/05/93	11/05/93	11/05/93	11/05/93	11/05/93
TAL METAL	Aluminum	2800	6710 !	8170 !	7680 !	8390 !	3550
	Arsenic	9.64 J!#	34.1 J!@	32.7 J!@	37.1 J!@	40.9 J!@	23.1 J!#
	Barium	19.1	40.0 J!	49.6 !	50.7 J!	52.9 J!	21.2 J
	Beryllium	< 0.500	< 0.500	< 0.500	< 0.500	0.491 J!@	< 0.500
	Cadmium	1.35 K#	< 0.500 J	1.69 KJ#	2.45 KJ!#	< 0.500 J	< 0.500 J
	Calcium	1280 !	5160 !	6430 !	5830 J!	5840 !	2590 J!
	Chromium	7.24	13.5 J!	16.3 J!	14.6 J!	16.8 J!	9.13 J
	Cobalt	3.91 !	9.66 !	12.3 !	9.89 J!	14.8 !	3.60 J
	Copper	2.11 J	7.76 J!	10.3 !	14.0 !	20.9 !#	6.98 !
	Iron	5210	13900 !	17600 !	14600 !	15300 !	6280
	Lead	8.82 !	22.1 !	27.0 !	93.0 !#	111 !#	46.4 !#
	Magnesium	979 J	829 J	1100 J	949 J	1000 J	526 J
	Manganese	63.2	161 !	204 !	181 !	189 !	65.1
	Nickel	5.21	12.7 !	16.7 !#	22.7 !#	18.3 !#	7.97 !
	Potassium	526 K	950 J	458 KJ	1450 J	681 J	< 200
	Selenium	< 0.200	1.42 J!	2.47 !	< 0.200	< 0.200	0.878 J!
	Silver	< 0.200	< 0.200	< 0.200	3.05 #	< 0.200	< 0.200
	Sodium	96.8 BJ	428 J	491 J	< 200	709 J	< 200
	Vanadium	5.98	14.2 J	18.0 !	29.6 !	38.2 !	12.4
	Zinc	20.7	54.2 !	77.2 !	142 !#	123 !#	61.0 !
TCL Pest	P,P-DDD	< 0.010	< 0.010	0.065 JC#	0.250 C#	0.083 JC#	0.110 C#
	P,P-DDE	< 0.010	< 0.010 J	< 0.010	0.160 C#	< 0.010	0.058 JC#
TOC	Total Organic Carbon	22200	334000	336000	349000	372000	449000

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 1-7
Chemical Summary Report For Puffer Pond Sediments
Area of Contamination: BK3
Units: UGG

	Site ID	E3-PUF-D06					
	Field Sample ID	DXPUF061					
	Sample Date	11/05/93					
Test	Parameter .						
TAL METAL	Aluminum	8580 !					
	Arsenic	42.4 J!@#					
	Barium	55.1 !					
	Beryllium	< 0.500					
	Cadmium	< 0.500 J					
	Calcium	7550 !					
	Chromium	16.5 J!					
	Cobalt	11.4 !					
	Copper	15.1 !					
	Iron	17700 !					
	Lead	45.0 !#					
	Magnesium	1010 J					
	Manganese	216 !					
	Nickel	20.0 !#					
	Potassium	< 200					
	Selenium	< 0.200					
	Silver	2.87 #					
	Sodium	808 J					
	Vanadium	22.4 !					
	Zinc	96.4 !					
TCL Pest	P,P-DDD	0.110 C#					
	P,P-DDE	0.071 JC#					
TOC	Total Organic Carbon	335000					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

concentration was 19 μg/g. Arsenic was measured at 6.68 μg/g and 7 μg/g at the crossing of Taylor Brook at Puffer Road. Arsenic was found in concentrations below the screening level of 6 μg/g (Ontario MOE LEL) in the wetlands east of Site P6 and slightly above the screening level in the wetlands west of Site A3. Arsenic (10 μg/g) was also found at a concentration above the screening level in a sediment sample (SED2) in the stream that flows from a point near the DEC facility to a point crossing under Patrol Road. This sample point is downgradient of Site P27, where arsenic was found in soil samples above soil screening levels. This stream joins the drainage from Puffer Pond just south of Patrol Road.

DDT and its degradation products DDD and DDE were found at the point where Taylor Brook crosses Puffer Road (north of Puffer Pond) and in one sample taken in the wetlands east of Site P6. These were the only locations in Watershed 1A, apart from Puffer Pond, where these pesticides were found in concentrations above background and screening levels. PAH compounds were found in the sediment samples (FW1SD12 and SED5) taken on Taylor Brook at Puffer Road crossing north of Puffer Pond. PAHs were not detected in Puffer Pond sediments or elsewhere in Watershed 1A, except those found in the background sample taken downstream of Digital Equipment Corporation (DEC). The drainage from the DEC site joins the drainage from Puffer Pond at a point below where PAHs were found at Puffer Road crossing. These PAHs may be related to the road traffic along Puffer Road or from passing vehicles.

1.1.2.5 Watershed 1A Assessment: Summary

The principal concern raised by analysis of surface water and sediment sampling results from Watershed 1A is the presence of arsenic in surface waters and sediments. Sampling results point to potential arsenic accumulation in Puffer Pond due to natural sources, a general source such as use of arsenic-based herbicides at the Annex, or a site-related source in the bunker area west of Puffer Pond. Organic-rich Puffer Pond sediment appears to be acting as a sink for arsenic in Watershed 1A. Arsenic concentrations in sediments generally decline downstream of Puffer Pond. One sample downgradient of Site P27 in a stream that feeds Taylor Brook, further downstream of Puffer Pond, may also indicate some site-related arsenic contamination. Further investigation of Sites P16, P27, and P54 should reveal whether the arsenic identified in Puffer Pond and streams and wetlands in Watershed 1A are site-related.

Lead was also found in Puffer Pond and in streams and wetlands in this watershed, but the detections were much more sporadic in surface waters and sediments than were those for arsenic.

Low levels of pesticides were found in Puffer Pond and in streams and wetlands in Watershed 1A. Most of these detections are probably the result of past pesticide management practices. One potential site-related source is Bunker 303, located west of Puffer Pond, where pesticides were stored. Further investigation at Bunker 303 should identify any migration of pesticides occurring from this bunker. PAHs were found only at one location in the watershed along the Puffer Road that crosses Taylor Brook north of Puffer Pond. These

results might be due to limited traffic at this location and therefore limited impact on the immediate surrounding sediments.

Graph 1-2 depicts arsenic concentrations found in soil samples at sites in Watershed 1A. The profile of arsenic detections in soil samples points to Sites P16, P27, and P54 as potential sources of arsenic in Watershed 1A. Graph 1-3 traces arsenic concentrations from the drainage from Cutting Pond through Puffer Pond to Taylor Brook, which exits the Annex near Site P42 in Watershed 1B. These graphs are presented to assist further investigations in locating potential sources of arsenic at the Annex. Tables 1-8 and 1-9 list the compounds found in surface waters and sediment above background and screening levels in Watershed 1A (except in Puffer Pond).

1.1.3 QA/QC Program Analysis of Results for Watershed 1A

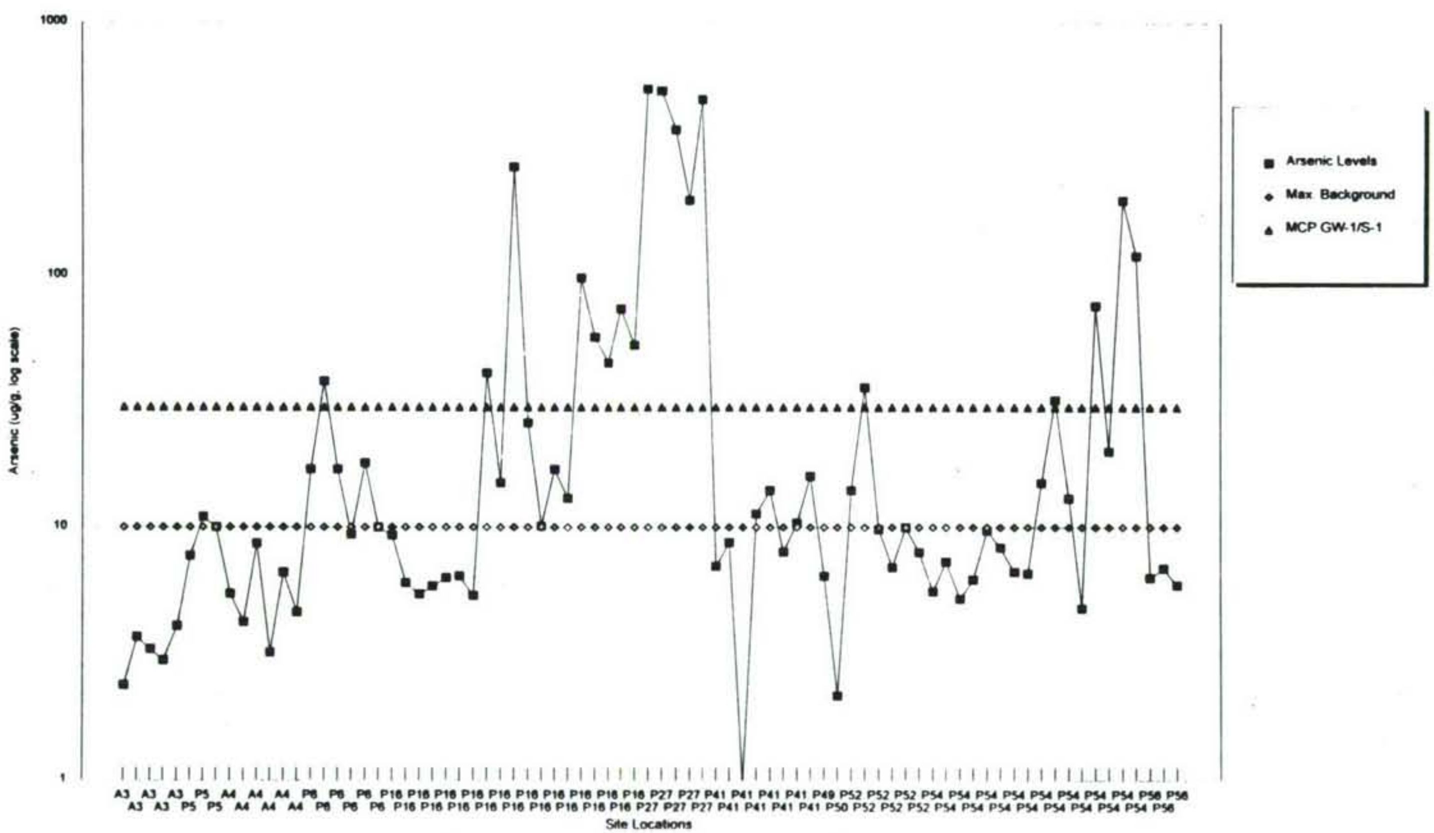
This section provides a summary of the results of the QA/QC review performed using the protocol described in Volume I, Section 5.3.3.

Data for Watershed 1A were evaluated for usability by reviewing laboratory and field QC sample data for contamination possibly introduced into field samples by either sampling or analysis procedures. First, method blanks were reviewed for each analyte in the 131 lots associated with Watershed 1A, followed by trip blanks and then rinsate blanks. Following consideration of laboratory and field QC blank samples data, laboratory flagging codes and United States Army Environmental Center (USAEC) data qualifiers were evaluated with laboratory control charts for each lot to assess potential analytical QC problems. Analytical results were then reviewed for precision and accuracy through consideration of the relative percent difference (RPD) between each sample/duplicate pair and matrix spike/matrix spike duplicate (MS/MSD) sample set and MS/MSD spike and surrogate recoveries.

A discussion of samples for each site affected qualified as part of the QA/QC evaluation. Samples with contamination also found in the blank were qualified either with a "B" usability code for "present in the blank" or a "K" usability code for a result-biased high. Samples considered to have QA/QC problems were qualified with an "L" usability code for a result-biased low, "R" for rejected, or "J" usability code for estimated. Appendix F provides a list of all QC summary data for method blanks, trip blanks, rinsate blanks, field duplicate samples, and MS/MSD samples.

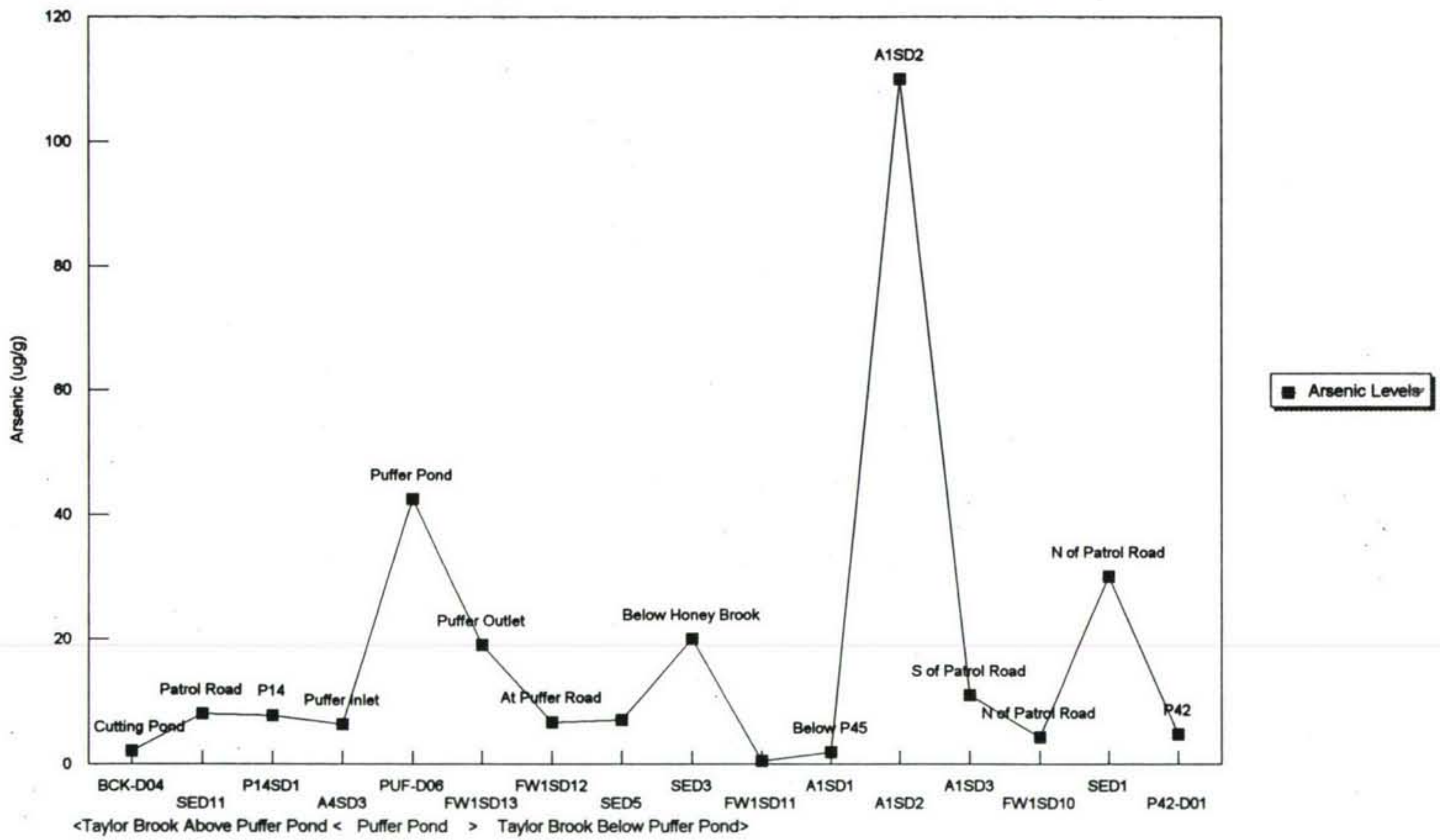
1.1.3.1 Site P6 — Puffer Pond Possible Dump Area

Blank contamination was found for 13 analytes in 39 samples. Alpha-BHC, α-endosulfan, aldrin, endrin, endosulfan sulfate, and lindane were found in method blanks, and 1,3-dinitrobenzene, cadmium, potassium, sodium, lead, antimony, and zinc were found in rinsate samples. Potassium and sodium can be attributed to the source water while cadmium, lead, antimony, and zinc are probably due to particulates washed from the surface of the equipment. The presence of 1,3-dinitrobenzene could be due to carryover from laboratory equipment.



Source: Data from OHM, Inc. 1994; Ecology & Environment, 1994
Compiled by Ecology & Environment, 1994

Graph 1-2 Arsenic Concentrations in Soil at Sites in Watershed 1A



Note: Data from Ecology & Environment, 1994; OHM, 1994; Dames & Moore, 1986
Compiled by Ecology & Environment, 1994

Graph 1-3 Arsenic Concentrations in Sediments in Taylor Brook

Table 1-8

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SURFACE WATERS IN STREAMS AND WETLANDS IN WATERSHED 1A (μg/L)

Compound	Maximum Background	Screen Level	Source	Highest Concentration	Sample ID	Above Background and Screen Levels	
						Locations Found	Frequency
Arsenic	3.15 (stream)	0.018	MA/CWA WQC[1]	9.19	A3SW1	Wetlands west of A3, A4 drainage, Wetlands east of P6.	4/11
Iron	4,810 (stream)	1,000	MA/CWA WQC[2]	11,000	P6SW1	Wetlands east of P6.	1/13
Lead	10.3 (stream)	3.2	MA/CWA WQC[2]	11.1	P6SW2	Wetlands west of A3, wetlands east of P6.	2/11[3] 4/11[3]
Manganese	156 (stream)	--	--	684	P6SW1	Wetlands east of P6.	1/13

[1]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for human consumption of water and fish.
[2]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for protection of aquatic life.
[3]Above WQC.

Source: Ecology and Environment, Inc. 1994.

Table 1-9

DETECTIONS ABOVE BACKGROUND AND SCREENING LEVELS
IN SEDIMENTS IN STREAMS AND WETLANDS IN WATERSHED 1A (μg/g)

Compound	Maximum Background	Screen Level	Source	Highest Concentration	Sample ID	Above Background and Screen Level	
						Locations Found	Frequency
Arsenic	2.03	6	Ontario MOE LEL[1]	36	A4SD2	Wetlands west of A3; A4 drainage; P14 drainage; Taylor Brook at road crossing north of Puffer Pond; Tributary to Taylor Brook.	9/13
Copper	6.33	16	Ontario MOE LEL	24.3	P14SD1	P14 drainage.	1/11
DDD	--	0.002	NOAA ERL[2]	0.154	FW1SD12	Taylor Brook at road crossing north of Puffer Pond; Wetlands east of P6.	2/11
DDE	--	0.002	NOAA ERL	0.038	P6SD1	Taylor Brook at road crossing north of Puffer Pond; Wetlands east of P6.	2/11
DDT	--	0.001	NOAA ERL	0.065	FW1SD12	Taylor Brook at road crossing north of Puffer Pond.	1/11
Benzo(*a*) anthracene	--	0.23	NOAA ERL	0.5	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Benzo(*a*) pyrene	--	0.4	NOAA ERL	1.0	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Benzo(*b*) fluoranthene	--	0.7	MCP GW-1/S-1 (soil value)[3]	0.77	FW1SD12	Taylor Brook at road crossing north of Puffer Pond.	1/13
Benzo(*k*) fluoranthene	--	0.7	MCP GW-1/S-1 (soil value)	2.0	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Chrysene	--	0.4	NOAA ERL	0.6	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Dibenzo(*a,h*) anthracene	--	0.06	NOAA ERL	0.2	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Fluoranthene	--	0.6	NOAA ERL	0.8	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Indeno (1,2,3-c,d) pyrene	--	0.7	MCP GW-1/S-1 (soil value)	0.9	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Phenanthrene	--	0.225	NOAA ERL	0.9	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13
Pyrene	--	0.35	NOAA ERL	0.5	SED5	Taylor Brook at road crossing north of Puffer Pond.	1/13

[1]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level
[2]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low
[3]MCP GW-1/S-1 = Massachusetts Contingency Plan Groundwater and Soil Categories.

Source: Ecology and Environment, Inc. 1994.

There were only four analytes in fourteen samples which were biased high due to blank contamination. These analytes were potassium in five samples, sodium in one sample, lead in two samples, and zinc in six samples.

After review of the precision of duplicate pairs, only dieldrin, endrin, lindane, and DDT were found to be outside of the RPD control limits in only one duplicate pair (SDP06011/SXP06011) from Site A06. Following USAEC Guidelines, only this pair of samples was qualified as estimated.

Laboratory control charts indicated only one QC problem: antimony in lot ABAQ was biased low due to low recoveries.

1.1.3.2 Site P16 — Chemical and Waste Storage Bunkers 302, 306, and 309

Analytes found in any of the thirteen field samples attributable to laboratory or field QC blank samples were acetone, cadmium, sodium, and antimony in rinsate blanks, and α-endosulfan, methylene chloride, dieldrin, endrin, endosulfan sulfate, and heptachlor epoxide found in method blanks. These analytes were due to either common laboratory contamination or carryover from laboratory equipment.

Six analytes in ten field samples were biased high due to their presence in the field or laboratory blanks. These analytes were dieldrin, endrin, potassium, DDE, DDT, and antimony.

Benzo(*a*)anthracene, phenanthrene, DDD, DDE, DDT, and TOC were found to be outside of the RPD control limits in only one duplicate pair (SDP16011/SXP16011). Since these analytes are organic, only these two samples were qualified as estimated for these five analytes.

There were no laboratory QC or MS/MSD problems associated with this site.

1.1.3.3 Site P27 — Pyrotechnics Test Area

Only three analytes were found to be of concern in a total of five samples reviewed for Site P27: cadmium, methylene chloride, and antimony. Methylene chloride was found in a method blank, and cadmium and antimony were found in rinsate blanks. Only antimony was found in field samples at a concentration just higher than those found in blank samples. Thus, antimony was biased high and methylene chloride and cadmium were attributed to the blank.

1.1.3.4 Site P41 — Bunker 303 Pesticide/Herbicide Storage

Six samples contained one or more of the 10 analytes found in blank samples analyzed for Site P41. Of these ten analytes, α-endosulfan, aldrin, endrin, endosulfan sulfate, and lindane were found in method blanks, while cadmium, heptachlor, sodium, and antimony were found in the rinsate blanks.

Cadmium, endrin, endosulfan sulfate, and potassium were found in the samples at concentrations which were greater than five times but less than 10 times the concentrations found in either the rinsate or method blanks. Accordingly, these results were biased high.

The only QC problem found was that antimony was biased low in one sample from lot ABAQ due to low recoveries.

1.1.3.5 Site P43 — Disturbed Area/Stained Soils and Stressed Vegetation

Only aluminum, iron, and zinc were found in the blanks associated with groundwater samples MXP43031 or MXP43GZ1. Aluminum and zinc were found in both the method and rinsate blanks, and iron was only found in the rinsate blank. In all samples, with the exception of iron for sample MXP43031, the analytes were qualified as attributable to the blank. In this sample, iron was qualified as biased high.

There were no other QC problems for Site P43.

1.1.3.6 Site P52 — Possible Dump Near FEMA Property

Three analytes (cadmium, methylene chloride, and potassium) were found in the blanks associated with six samples. Cadmium was repeatedly found in the rinsate blank and was qualified in the samples as present in the blank. Methylene chloride was found in the method blank. Potassium was found in the rinsate blank at concentrations to either qualify results as present in the blank or biased high due to the blank.

No other QC problems were found for Site P52.

1.1.3.7 Site P54 - Additional Bunkers 305, 307, and 314

The following analytes were found in concentrations in the laboratory or field QC blank samples that affected ten field samples: acetone, α-endosulfan, bis(2-ethylhexyl)-phthalate, methylene chloride, dieldrin, di-N-butyl phthalate, endrin, endosulfan sulfate, and heptachlor epoxide from method blank contamination, and acetone, cadmium, methylene chloride, heptachlor, sodium, and antimony from rinsate blank contamination. In addition, dieldrin, endrin, potassium, and antimony were found in some samples just exceeding the comparison level based on the concentration found in a blank sample. As a result, some samples were biased high as opposed to being qualified as present in the blank.

The only other QC issue at Site P54 was in the review of MS/MSD data. All ten surface soil samples exhibited low recoveries in the matrix spike/matrix spike duplicate for arsenic. As a result, all ten samples were qualified as estimated for arsenic.

1.1.3.8 Site P56 — Cleared Area South of Bunker 313

Method blank samples analyzed for Site P56 affected data for α-BHC, α-endosulfan, methylene chloride, dieldrin, endrin, endosulfan sulfate, lindane, and DDE in field samples.

In ten samples, these analytes were found in concentrations in the method blank to either qualify data as found in the blank or biased high due to the blank. Arsenic, cadmium, heptachlor, heptachlor epoxide, potassium, sodium, lead, and zinc concentrations found in the rinsate blanks were sufficient to qualify nine samples as either found in the blank or biased high due to the blank.

A review of the precision based on the MS/MSD taken for sample EXP56011 called for results for antimony to be qualified as estimated due to low recoveries in the spiked sample.

1.2 SITE DESCRIPTIONS AND ASSESSMENTS

1.2.1 Site P6 — Puffer Pond Possible Dump Area

During 1990, a series of interviews were carried out by the Army with employees from Natick Laboratory regarding possible disposal or dumping of chemical wastes at the Annex (Fort Devens 1990). During these interviews, Site P6 was identified by one employee as a possible chemical dump area. Figure 1-2 depicts area layout and physical characteristics.

1.2.1.1 Site Location

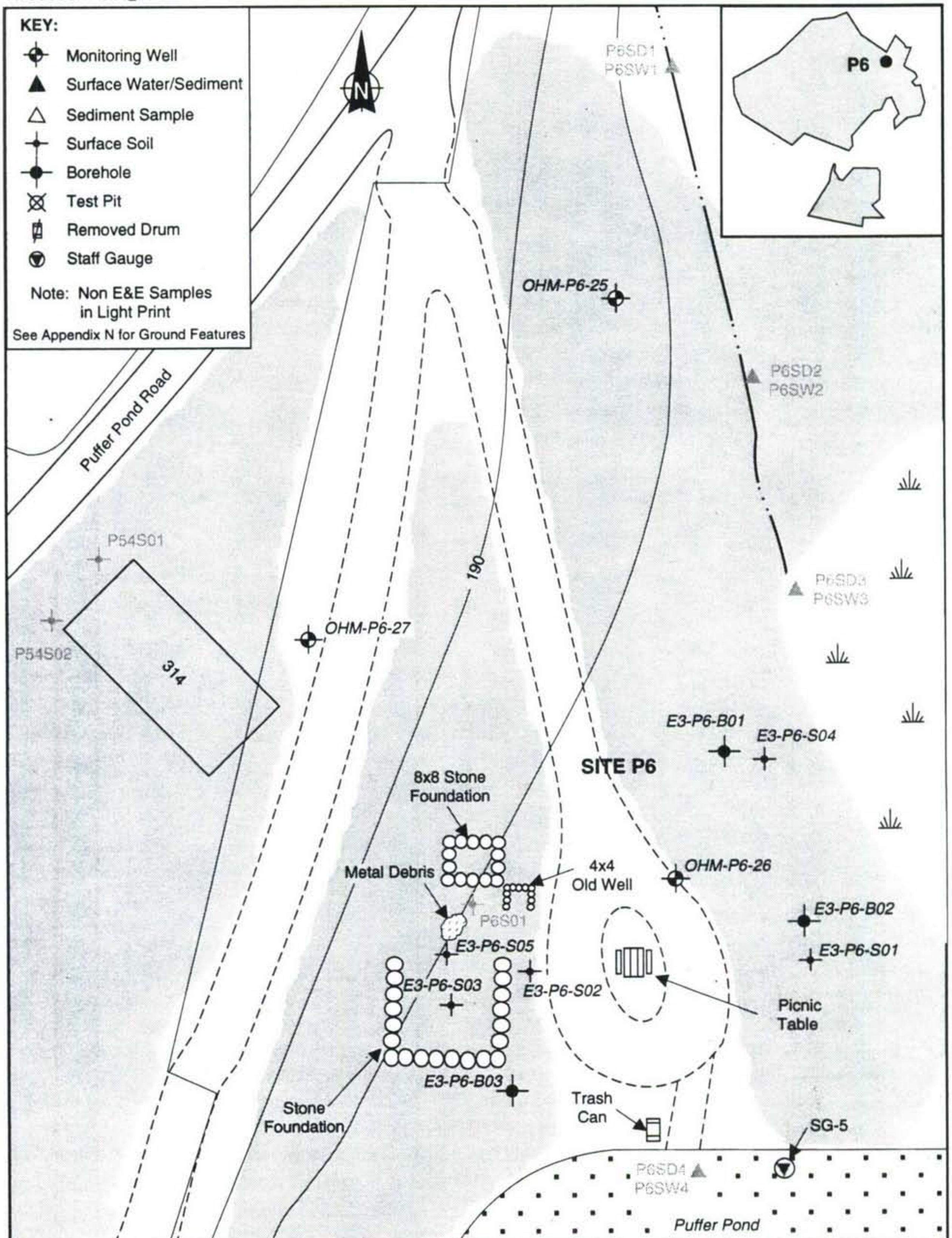
The Puffer Pond possible dump area (Site P6) is located in the forest between the northern shore of Puffer Pond and Puffer Pond Road. The dirt access road into the area splits and ends in an oval loop by an old landing stage on the shore of Puffer Pond. A drum filled with leaves and broken branches stands beside this landing. In the center of the access road loop there is a picnic table. On the western part of Site P6, about 100 feet west of the center of the access road loop, there is an 8 foot by 8 foot stone foundation next to a 4 foot by 4 foot stone-lined pit, likely an old well. Another stone foundation lies south of the debris area. Metal debris is scattered between the two stone foundations.

1.2.1.2 Physical Characteristics

Site P6 lies on a glacial outwash plain of sand and gravel adjoining a kettle pond (Puffer Pond) to the south and a wetland to the east. Surface topography slopes steadily south across the site to Puffer Pond with ground surface elevations ranging from 190 in the south to 200 feet above mean sea level (AMSL) to the north. The average groundwater elevation at the site is 182 feet AMSL with little seasonal fluctuation. Surface water elevations in Puffer Pond have also been observed at approximately 182 feet AMSL according to surface water gauge SG-5. Water elevation in Puffer Pond was recorded at 178 feet in 1955 (Hansen 1956); recent increased elevations can be attributed to the damming of Taylor Brook by beavers. The beaver dams were removed early in the fall of 1993 because they caused Patrol Road to flood; the dams may also have had an impact on the elevation of water in Puffer Pond.

OHM installed three monitoring wells (OHM-P6-25, OHM-P6-26, and OHM-P6-27) at Site P6 in 1992. The deepest well was drilled to a depth of 25 feet. Drilling logs and observations collected during well installation confirm that the site is immediately underlain by at least 25 feet of outwash material consisting of poorly sorted sand with trace silt and gravel. Three shallow boreholes installed by E & E in 1993 to a maximum depth of 9 feet BGS encountered similar material. Surface soil sample E3-P06-S02 was submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as non-plastic silty sand. Appendix D contains a complete summary of geotechnical results. Buried debris, visually contaminated soil, or odors were not noted either at the time of the OHM well installation or during E & E borings.

11: SUDBURY\UC6_P6.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-2 MAP OF SITE P6
PUFFER POND POSSIBLE DUMP AREA

Bedrock was not encountered at any of the Site P6 boring or monitoring well locations. Depth to bedrock is unknown but is greater than 25 feet BGS based on drilling exploration. The underlying bedrock is projected to be the Marlboro Formation (Hansen 1956).

OHM calculated an average transmissivity of 100 $feet^2$ per day for the three wells located at Site P6. This information is based on slug test data and an estimated aquifer thickness of 30 feet. Apparently, this thickness estimate was based on the range of aquifer thickness values across the installation. This transmissivity figure is consistent with that of other wells installed in similar material on the Annex.

Surface water flows east and southeast from the site to the adjacent wetland and Puffer Pond. Based on hydrogeologic and water level data, groundwater also flows east and southeast to the wetland and Puffer Pond.

1.2.1.3 Ecological Characteristics

Except for the dirt road that leads to Site P6, most of the site is densely vegetated with white pine and oak trees ranging from 40 to 60 feet in height (LFS 1983). Due to the dense canopy closure, the understory is very sparse and limited to overstory regeneration. The ground is covered by a thick mat of pine needles.

Surface water runoff flows to the south and east of the site through a narrow, emergent wetland dominated by sedges, cattails, and bulrushes and into Puffer Pond, a permanent open body of water extending for approximately 2,000 feet from north to south and approximately 1,000 feet from east to west. In addition, less than 200 feet east of the site and immediately north of Puffer Pond, there is a forested wetland which is hydrologically connected to the site. This area is a seasonally saturated wetland partially vegetated with deciduous trees (U.S. Department of the Interior (USDOI) 1977).

This area provides a variety of different habitats including upland forest, emergent wetland, forested wetland, and open water. Pines and oaks are very important to wildlife since upland game birds, songbirds, and small mammals rely on pine seeds and acorns for much of their diet (Martin *et al*. 1951). In addition, the dense growth of pine trees also serves as valuable cover for deer and rabbits, especially in the winter. Open bodies of water such as Puffer Pond provide drinking water, food, breeding areas, and shelter for both permanent residents as well as animals that regularly visit from other habitats. For example, amphibians, reptiles, and waterfowl predominantly occur in the shallow portions of the pond, while piscivorous birds feed on fish throughout the pond. Forested wetlands combine an abundance of nutrients, the presence of diverse woody species, and the availability of water. Consequently, such areas attract a diverse array of aquatic species, upland species, as well as species specifically adapted to wetlands.

The small beggar tick (*Bidens discoidea*), a Massachusetts watch-list plant species, has been documented on the southern part of Site P6 and the northern shore of Puffer Pond (Hunt 1992). This species prefers moist soils on the shores of ponds or wetlands. Therefore,

the wetland north of Puffer Pond and east of the site satisfies this habitat requirement and could potentially support a population of these plants. No unique habitats have been identified in the general vicinity of the site [Natural Heritage and Endangered Species Program (NHESP) 1992].

1.2.1.4 Site History

Interviews with Natick Laboratory employees about possible locations of chemical disposal and burial were used to identify Site P6 (Fort Devens 1990; Interview 1990b). Interviewees stated that chemical disposal took place near a body of water at the Annex, which may have been Puffer Pond. No other information regarding the disposal location was found.

Roads have existed near Site P6 since the establishment of the Maynard Ammunition Depot in 1942. A 1944 map locates an area where excavated soil material (or spoil) is deposited south of Site P6 along the edge of Puffer Pond. This area was approximately 500 feet long by 100 feet wide. Spoil was deposited there during base construction. A 1942 map of the facility locates an structure, later identified as a log cabin, in the area. This cabin was later named Building T224, and was reportedly used as an Non-Commissioned Officer's (NCO) club during World War II. Building T224 was demolished around 1959. The picnic table, boat ramp and loop road seem to indicate that Site P6 was used as a recreational area.

1.2.1.5 Results of Previous Investigations

An SI report for Site P6 was completed by OHM in 1992. A detailed description of the results of the investigation is presented in Section 7.15 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). Work at Site P6 before the Phase II effort consists of the OHM SI, which included an area reconnaissance, a soil-gas survey, soil sampling, monitoring well installation and sampling, and surface water and sediment sampling.

A soil-gas survey was conducted by OHM in August 1991 to investigate the extent of potential contamination. No specific volatile aromatic compounds or chlorinated solvents were detected. Photoionization detector (PID) readings indicated total volatile organic compound (VOC) concentrations volatile organics of up to 789 μg/L. The volatile elution pattern was characteristic of naturally occurring terpenes. Electromagnetic (EM), magnetic, and Scanner Magnetometric (SM) surveys performed in July 1991 revealed surface debris, shallow scrap metal, and several drums visible from the surface. This study covered an area approximately 150 feet wide by 500 feet long along the eastern side of the dirt road that leads from Puffer Pond Road to the edge of Puffer Pond.

OHM installed three shallow monitoring wells in May 1992. During the two groundwater sampling events in June and October 1992, no odors or PID readings above background were noted. Analyses of the groundwater samples, in October 1992, showed heptachlor epoxide at trace levels in two wells (OHM-P6-25 and OHM-P6-26), and a sulfur level of 13 μg/L in one well (OHM-P6-26).

In April 1992, surface soil sample P6S01 was collected and found to contain mercury (0.354 $\mu g/g$), lead (240 $\mu g/g$), and residues of DDT and its degradation product, DDE. This sample was collected near buried metal debris, which may account for the high metal concentrations. Sediment samples contained low levels of DDT and its degradation products. These concentrations are possibly the result of general pesticide spraying practices in the past. Surface water samples contained levels of iron, lead, and manganese found in the concentrations above Ambient Water Quality Criteria (AWQC). The levels of iron and manganese were consistent with levels of these metals in surface water and groundwater at the Annex, and probably reflect background conditions. Table 1-2 provides a summary of the Phase II sampling efforts at Site P6.

1.2.1.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for target compound list (TCL) pesticides, polychlorinated biphenyl (PCBs), target analyte list (TAL) metals, explosives, and TPHC. In addition, two surface soil samples were analyzed for TOC. Surface soil samples and groundwater samples were also analyzed for organophosphorus pesticides. One surface soil sample was sent for geotechnical analysis to determine grain size distribution. A summary of Phase II Sampling Activities at Site P6 is provided as Table 1-10.

Table 1-10

PHASE II SAMPLING EFFORT AT SITE P6 — PUFFER POND POSSIBLE DUMP AREA

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	3	08/26/93	Samples were collected to investigate groundwater quality and the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	6	08/04/93 08/05/93	Samples were collected to investigate the presence of any subsurface soil contamination.
	3	08/04/93 08/05/93	Geotechnical samples were collected to provide data on the nature of subsurface soils.
Surface Soils	5	09/14/93 09/15/93	Samples were collected to characterize surface contamination, if any, in areas with stressed vegetation or obvious soil discoloration, or from surface drainage channels.
	1	09/15/93	A geotechnical sample was collected at location E3-P06-02 to characterize the nature of surface soils.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

In order to characterize groundwater quality at Site P6, E & E sampled three existing wells during the first round of groundwater sampling in late August 1993. Two of the three wells (OHM-P6-25 and OHM-P6-26) are located downgradient of areas where disposal may have taken place in the past and the wells were positioned in line with groundwater flow towards Puffer Pond and the adjoining wetland to the east.

Subsurface Soil Sampling

Three borings were completed at Site P6 to characterize subsurface soil contamination and assess the potential for contaminant migration through the groundwater pathway. The three completed borings (E3-P06-B01, E3-P06-B02, and E3-P06-B03) are located downgradient of suspected disposal areas and upgradient of Puffer Pond. A total of six samples were collected, two from each boring, one at a depth of 0 to 2 feet BGS, and one at 4 to 6 feet BGS.

Geotechnical samples were collected from each boring from depths above the water table and sent for grain size and Atterberg limits analyses, as appropriate. These physical analyses provide data to assess the nature of subsurface soils and provide a quality assurance check on the classification of soils by the field geologists.

Surface Soil Sampling

To investigate the nature of surface contamination, five locations were sampled from areas with stressed vegetation, obvious soil discoloration, or from surface drainage pathways. Two samples (E3-P06-S03 and E3-P06-S05) were collected downgradient (south) of partially buried metal debris and a concrete foundation to characterize this area as a possible source of surface contamination. The remaining three samples were collected from surface drainage channels to assess the potential for surface contamination to migrate in the surface runoff pathway. Two of the samples (E3-P06-01 and E3-P06-S03) were analyzed for TOC. E3-P06-S02 was analyzed for grain size distribution to characterize site surface soils.

1.2.1.7 Nature and Extent of Contamination

Analysis of unfiltered groundwater samples taken in the August 1993 sampling round from the three shallow monitoring wells at Site P6 indicated the presence of concentrations of arsenic, aluminum, iron, and manganese above preliminary screening values. A summary of the detections above preliminary screening levels is provided in Table 1-11. The analytical results of the samples from Site P6 are presented in the Chemical Summary Report for Groundwater, Table 1-12; Chemical Summary Report for Subsurface Soils, Table 1-13, and Chemical Summary Report for Surficial Soils, Table 1-14 following Section 1.2.1.8. Conclusions and Recommendations. These concentrations are most likely the result of suspended solids in the groundwater.

Table 1-11

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P6

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Sample ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1]	--	50	MA SMCL[2]	17,000	OHM-P6-26	3/3
	Arsenic(U)	--	50	MA SMCL	63.1	OHM-P6-27	1/3
	Iron(U)	--	300	MA SMCL	18,000	OHM-P6-26	3/3
	Manganese(U)	--	50	MA SMCL	284	OHM-P6-27	3/3
SOIL (μg/g)	Arsenic	17	10	MCP GW-1/S-1[3]	38.0	E3-P06-S01	1/5

[1]U = Unfiltered groundwater sample.
[2]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[3]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994

Arsenic was found in well OHM-P6-27 at 63.1 μg/L which exceeds the Massachusetts Maximum Contaminant Level (MCL) of 50 μg/L. However, it is not likely that OHM-P6-27 is contaminated by Site P6. If groundwater flows east and southeast, as indicated by hydrogeologic and water level data, then OHM-P6-27 is either cross-gradient or upgradient of Site P6. If not derived from natural background levels in the aquifer materials, then the arsenic found in OHM-P6-27 may be related to sources west of Site P6 in the bunker area. Arsenic was not found in the earlier filtered groundwater samples taken by OHM in 1992 at Site P6. Other metals found exceeding Massachusetts Secondary MCLs (MA SMCLs) in unfiltered samples from all three monitoring wells were aluminum, iron, and manganese.

While arsenic was found in the three monitoring wells related to Site P6, arsenic was not found at concentrations above background levels in subsurface soil samples taken from three soil borings at the site. The only metal found in subsurface soil samples above surface soil background levels was manganese (130 μg/g) in boring E3-P06-B01 at the 0 to 2 foot sampling depth. This amount is below any soil screening level for manganese. DDT and its breakdown product DDE were found in low levels in soil boring samples, but below soil screening values. TPHC (up to 19.1 μg/g) were found in three out of six soil boring samples.

Arsenic and manganese were the only metals found in surface soil samples above soil background levels. Arsenic (38.0 μg/g) was found in only one sample at E3-P06-S01, at a concentration above the soil screening value of 30 μg/g (MCP GW-1/S-1 and GW-3/S-3). This sample was taken downgradient of the metal debris and concrete foundation at the site. However, soil samples at locations close to the metal debris (at E3-P06-S02, E3-P06-S03, and E3-P06-S05) had concentrations of arsenic that were less than half the arsenic concentration found at E3-P06-01, and were not above background soil levels.

Organic compounds detected in soil at P06 included trace amounts of pesticides and TPHC. All pesticides were found at concentrations below soil screening values. The residual pesticides are probably the result of past pesticide spraying practices at the Annex and are not considered to be site-related. TPHC were found in five out of six soil samples, at concentrations up to 44.5 μg/g which were below the soil screening value of 500 μg/g (MCP GW-1/S-1 soil value). The TPHC found in soil may also be related to pesticide spraying practices in the event that DDT/oil mixtures were sprayed in this area.

1.2.1.8 Conclusions and Recommendations

The initial concern at Site P6 was the potential dumping or burial of chemicals at the site. Sampling has not yet identified any solvents or other chemical constituents likely to be related to chemical dumping in groundwater, soil, or surface water. Mercury (0.354 μg/g) and lead (240 μg/g) were found in one soil sample taken by OHM near the metal debris at the site, but at concentrations below the most conservative soil screening levels (MCP GW-1/S-1) for mercury (10 μg/g) and for lead (300 μg/g). Subsequent soil sampling by E & E in the runoff paths from the metal debris toward Puffer Pond did not detect mercury, and did not detect lead at concentrations above background levels at Annex. Thus, it appears that surficial contamination may be limited to a small area adjacent to the metal debris.

Arsenic found in one of three wells, OHM-P06-27, in unfiltered samples taken during the August 1993 round of groundwater sampling was slightly above the MA MCL screening level of 50 μg/L. This level is still far below the MCP GW-3 level of 400 μg/L for groundwater not used for drinking. This result is most likely due to the presence of suspended solids in the unfiltered groundwater sample. No arsenic was found in earlier filtered sampling by OHM in 1992.

Sampling results at Site P6 have not uncovered any evidence of solvent chemical disposal. Arsenic was found in concentrations above screening levels in one soil sample and in one unfiltered groundwater sample at the site, but given results of other samples at the site, these detections do not indicate site-wide contamination. The exact source of the arsenic is unknown, and thus further action is recommended at this site, pending the results of arsenic studies at other sites at the Annex that may identify specific source(s) of arsenic at the Annex.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 1-12
Chemical Summary Report For Groundwater
Site: P06
Units: UGL

	Site ID	OHM-P6-25	OHM-P6-25	OHM-P6-26	OHM-P6-26	OHM-P6-27	OHM-P6-27
	Field Sample ID	MXP06251	MXP06251	MXP06261	MXP06261	MXP06271	MXP06271
	Sample Date	08/26/93	08/27/93	08/26/93	08/27/93	08/26/93	08/27/93
Test	Parameter .						
TAL METAL	Aluminum	4210 @		17000 @		16000 @	
	Arsenic	8.24		37.9		63.1 @	
	Barium	64.9		70.7		50.6	
	Beryllium	0.425 J		0.940 J		0.856 J	
	Calcium	4470		13700		3260	
	Chromium	9.37 J		26.0		21.1	
	Cobalt	7.14 J		14.0		13.1	
	Copper	2.34 J		15.8		12.5	
	Iron	4990 @		18000 @		13000 @	
	Lead	3.66 J		10.7		12.4	
	Magnesium	1070		4400		2660	
	Manganese	280 @		233 @		284 @	
	Nickel	11.4		24.9		19.2	
	Potassium	1340		3300		2520	
	Sodium	2690		3160		2430	
	Vanadium	5.92 J		24.3		17.0	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 1-13
Chemical Summary Report For Subsurface Soils
Site: P06
Units: UGG

	Site ID	E3-P06-B01	E3-P06-B01	E3-P06-B02	E3-P06-B02	E3-P06-B03	E3-P06-B03
	Field Sample ID	BX060101	BX060102	BX060201	BX060202	BX060301	BX060302
	Sample Date	08/04/93	08/04/93	08/05/93	08/05/93	08/05/93	08/05/93
Test	Parameter / Depth	0.0 ft.	4.0 ft.	0.0 ft.	4.0 ft.	0.0 ft.	4.0 ft.
EXPLOSIVES	2-Nitrotoluene	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
TAL METAL	Aluminum	7300	5000	8100	4200	6100	4500
	Arsenic	6.32	7.21	4.68	7.53	5.47	3.45
	Barium	17.1	10.7	14.8	10.8	14.8	9.76
	Beryllium	0.280 J	0.200 J	0.375 J	0.225 J	0.290 J	0.206 J
	Cadmium	0.310 J	0.258 J	0.367 J	0.254 J	0.196 J	< 0.500
	Calcium	338 J	417 J	505 J	466 J	< 500	< 500
	Chromium	7.72	7.51	11.2 K	7.13 K	9.89 K	9.10 K
	Cobalt	3.39	3.62	4.84	3.50	3.84	4.41
	Copper	5.54	5.34	6.87	4.65	5.52	5.97
	Iron	7900	6800	9300	5700	7000	7000
	Lead	9.71 K	7.32 B	4.89 B	2.37 B	14.0 K	2.64 B
	Magnesium	1160	1270	1500	1170	1230	1670
	Manganese	130 !	78.4	83.1	56.0	79.8	73.1
	Nickel	7.98	7.19	9.58	5.39	6.90	9.03
	Potassium	261 B	445 K	289 K	300 K	313 K	426 K
	Vanadium	8.86	7.72	11.0	7.49	10.0	8.43
	Zinc	18.5 K	18.0 K	20.0 K	12.6 K	17.2 K	20.4 K
TCL Pest	P,P-DDE	0.007 C	0.008 JC	0.004 JC	< 0.002	< 0.080	< 0.002
	P,P-DDT	0.013 C	0.039 C	0.010 C	0.002 JU	0.110 C	< 0.002
TPHC	Total Petroleum Hydrocarbons	< 20.0	16.8 J	< 20.0	17.1 J	19.1 J	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-14
Chemical Summary Report For Surficial Soils
Site: P06
Units: UGG

Test	Site ID / Field Sample ID / Sample Date / Parameter	E3-P06-S01 SDP06011 09/14/93	E3-P06-S01 SXP06011 09/14/93	E3-P06-S01 SXPO6011 09/23/93	E3-P06-S02 SXP06021 09/15/93	E3-P06-S03 SXP06031 09/15/93	E3-P06-S04 SXP06041 09/14/93
TAL METAL	Aluminum	4610	4940		5560	4580	6070
	Arsenic	38.0 !@	34.0 !@		17.0 !	9.35	18.0 !
	Barium	10.9	11.6		13.7	12.0	12.6
	Beryllium	0.166 J	0.181 J		0.240 JL	0.210 JL	0.239 J
	Calcium	291 J	287 J		342 J	184 J	340 J
	Chromium	6.06	6.13		7.73	6.86	8.16
	Cobalt	2.63	2.76		3.57	3.03	3.78
	Copper	4.36	4.46		4.39 L	4.48 L	6.88
	Iron	6130	6680		8020	6500	7570
	Lead	86.0	76.0		61.0	47.0	80.0
	Magnesium	850	921		103000 !	88700 !	1120
	Manganese	56.2	66.1		107 !	81.3	102 !
	Nickel	5.64	6.56		6.79	5.81	7.94
	Selenium	< 0.200	< 0.200		< 0.200 L	< 0.200 L	0.206 J
	Sodium	139 KJ	122 BJ		< 20000	< 20000	95.6 BJ
	Vanadium	9.73	9.86		15.2	9.46	17.2
	Zinc	33.0	30.1		24.1 J	45.6 J!	38.2
TCL Pest	Dieldrin	0.002 JC	0.001 JU		0.002 JU	0.001 JU	0.006 U
	Endosulfan,A	0.000 BJC	0.001 BJC		< 0.002	0.000 JC	< 0.002
	Heptachlor Epoxide	0.001 JC	< 0.002		0.001 JC	0.001 JC	0.001 JC
	P,P-DDE	0.011 C	0.007 C		0.073 C	0.015 C	0.120 C
	P,P-DDT	0.014 JC	0.005 JC		0.064 C	0.028 C	0.180 C
TOC	Total Organic Carbon				49700	31400	
TPHC	Total Petroleum Hydrocarbons	37.6	37.7		< 20.0	15.7 J	43.2

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 1-14
Chemical Summary Report For Surficial Soils
Site: P06
Units: UGG

	Site ID	E3-P06-S05	E3-P06-S05				
	Field Sample ID	SXP06051	SXP06051				
	Sample Date	09/14/93	09/23/93				
Test	Parameter .						
TAL METAL	Aluminum	5450					
	Arsenic	10.0					
	Barium	13.5					
	Beryllium	0.207 J					
	Calcium	305 J					
	Chromium	6.79					
	Cobalt	3.26					
	Copper	6.05					
	Iron	6800					
	Lead	46.0					
	Magnesium	984					
	Manganese	124 !					
	Nickel	6.91					
	Selenium	< 0.200					
	Sodium	100 BJ					
	Vanadium	10.1					
	Zinc	38.4					
TCL Pest	Dieldrin	0.002 U					
	Endosulfan,A	0.001 BJC					
	Heptachlor Epoxide	< 0.002					
	P,P-DDE	0.017 C					
	P,P-DDT	0.016 C					
TOC	Total Organic Carbon						
TPHC	Total Petroleum Hydrocarbons	44.5					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

1.2.2 Site P16 — Chemical and Waste Storage Bunkers 302, 306, and 309

Site P16 consists of three bunkers (302, 306, and 309) identified during a 1990 interview with Natick employees that were used to store waste chemicals (Fort Devens 1990). The area is illustrated in Figure 1-3.

1.2.2.1 Site Location

Site P16 is located in the central portion of the Annex on slightly elevated ground between wetland areas and Puffer Pond. The three bunkers that comprise Site P16, Bunker 302, Bunker 306, and Bunker 309, are located 800 feet west of Puffer Pond along a dirt road which, in this area, runs parallel to Puffer Pond Road. The three bunkers are surrounded by forest and their entrances face the dirt road. In front of each bunker the road widens into a small cleared area littered with scattered wooden and metal debris. Southwest of Bunker 309, there is a depression from a drum removal which took place during previous investigations. Another depression at Site P16 is located south of Bunker 306 and another one is in a cleared area between Bunker 306 and Bunker 308, located approximately 300 feet north of Bunker 306.

Site P41 (Bunker 303) is located approximately 300 feet south of Bunker 306. The three bunkers that make up Site P54 (305, 307, and 314) are located northwest, southeast, and northeast of Bunker 306 (see Figure 1-1).

1.2.2.2 Physical Characteristics

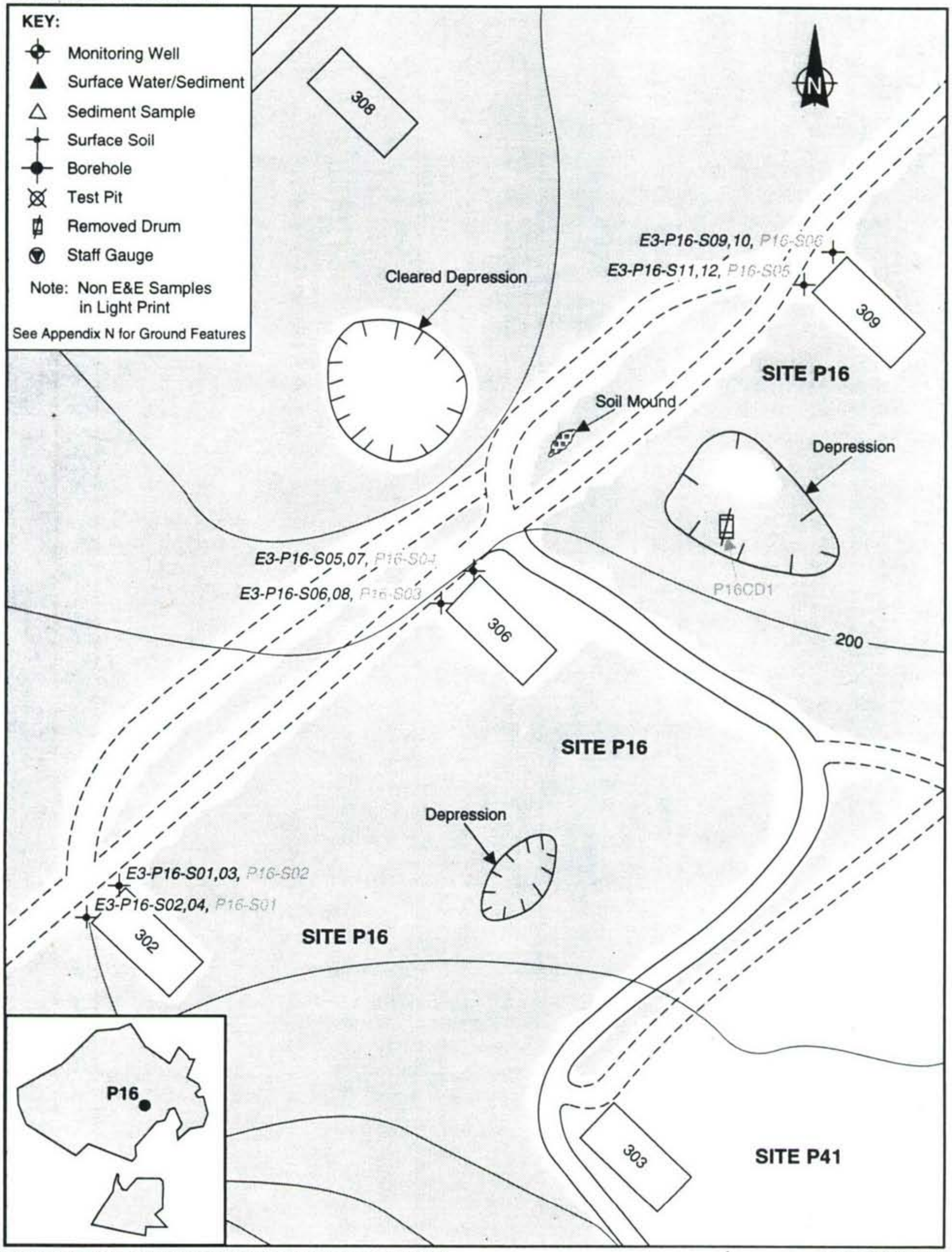
The three bunkers lie within 1,200 feet of each other, on a flat expanse of glacial outwash sand and gravel, between a wetland to the west and Puffer Pond to the east. Surface elevations at the site range from approximately 195 feet AMSL at Bunker 309 to over 200 feet at Bunker 302. No subsurface exploration occurred at Site P16; however, grain size and Atterberg limits analyses performed on surface soil sample E3-P16-S03, identified the surface soil in this area as non-plastic, well-graded sand with silt. Appendix D contains a summary of geotechnical results. The depth to bedrock is unknown but, the underlying bedrock is projected to be the Marlboro Formation (Hansen 1956).

Surface water flow from the site is northwest to the wetland and east toward Puffer Pond. Because of the well drained soil and flat surface, it is improbable that surface water runoff occurs except during snowmelt on frozen soil or during exceptional storms. No wells were installed at Site P16, but topography would suggest that groundwater is shallow (less than 15 feet BGS) and flow is toward Puffer Pond. Groundwater flow to the wetland west of these bunkers is also a possibility.

1.2.2.3 Ecological Characteristics

Site P16 is densely vegetated by white pine and oak trees ranging from 40 to 60 feet (Leupold Forestry Services (LFS) 1983). The local topography of the area indicates that

11: M:\SUDBURY\UC6_P16.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-3 MAP OF SITE P16 CHEMICAL AND WASTE STORAGE BUNKERS 302, 306, AND 309

surface water runoff flows either east or west. Located approximately 1,500 feet west-northwest of the site is a large, broad-leaved,deciduous and evergreen forested wetland (USDOI 1977). Approximately 800 feet downgradient of the site to the east is Puffer Pond, a large, open water area considered to be a receptor of local surface water runoff. In addition, two vernal pools are associated with this site. The first pool, located southwest of the site and within the forested wetland identified above, is known as Bunker Road Pool (Butler 1992). The second pool, known as Bunker Corner Pool (Butler 1992), is located downgradient and west of the site.

This area provides three main habitat types: upland forest, forested wetland, and open water. White pine forests provide nesting and roosting areas for songbirds and upland gamebirds while also providing cover for many species of mammals. The needles, seeds, and bark are consumed by various species of wildlife throughout the year (Martin *et al.* 1951). The oaks also provide a high-quality source of food for upland mammals, gamebirds, and song birds. Forested wetlands similar to the one northwest of the site provide nesting and roosting areas for songbirds, gamebirds, and migratory waterfowl while also providing habitat for various species of mammals, reptiles, and amphibians (Martin *et al.* 1951).

No unique habitats have been identified in the general vicinity of Site P16 (NHESP 1992). However, the Bunker Road vernal pool has been identified as a breeding pool for the spotted salamander (*Ambyostoma maculatum*), a state watch-list species (Butler 1992).

1.2.2.4 Site History

Site P16 consists of three bunkers that were used for the storage of waste chemicals collected at the Natick Laboratories prior to disposal at the Annex according to Natick Laboratory employees (Fort Devens 1990). Bunker inventories from 1964 through 1992 do not identify the storage of chemicals in any of these bunkers. However, chemical waste handling procedures at the Annex during the Natick period were informal and the inventories may not be complete.

Bunker 302 was used by a division of Natick Laboratories. In 1973, 1977, and 1982 inventories, the bunker was noted as being used by the Natick Food Experiment Laboratories (FEL) to store food subsistence items and food tray packs. In a 1992 bunker inspection, the bunker contained only empty pallets, and no apparent staining was noted within the bunker.

Bunker 306 was used by the Natick Supply Office in 1964, but was empty at the time of the 1964 inventory. In 1973, the bunker was being used by a division of Natick Laboratories, and conference displays were being stored there. In 1977, the Natick Supply Office was storing cages in the bunker, which were labeled "to be removed" during a 1982 inspection. A 1990 inspection also noted the storage of sheet metal duct work and heat exchangers. A 1992 bunker inspection revealed that the bunker contained boxes of high-efficiency particulate air (HEPA) filter (a type of particulate filter commonly used in laboratories). No staining was noted in 1992, except some white crystalline substance, likely to be mold, on the floor just inside the entrance.

Bunker 309 was being used by the Mechanical Engineering Division of Natick Laboratories in 1964. A 1973 inspection reports that the bunker was used for the storage of general supplies by a division of Natick Laboratories. In 1977, the bunker was used by Natick for the storage of food subsistence items from food irradiation experiments. A 1982 inspection noted storage of tray packs and food components. At the time of the 1992 inspection, ten large boxes of flameless, water-reactive heaters, miscellaneous kitchen equipment, and fire extinguishers were stored in the bunker.

1.2.2.5 Results of Previous Investigations

An SI for Site P16 was completed in 1992. Results of the investigation are included in Section 7.25 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994).

In 1992, all the bunkers at the Annex were inspected, both externally and internally. No visible stains or stressed vegetation were found outside the bunkers. Interior descriptions of these bunkers are included in the site history. In April 1992, surface soil samples were taken near the drains of each bunker. These samples were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, and TAL metals. Pesticides were clearly present as contaminants at these bunkers with the maximum concentration of DDT (22 μg/g), DDD (5.3 μg/g), and DDE (3.3 μg/g) found in sample P16S06 taken near Bunker 309. Dieldrin (0.028 μg/g) was also detected in sample P16S05 at Bunker 309, but not in the samples from the other bunkers. Numerous PAHs and related BNAs were detected primarily in sample P16S03 collected near Bunker 306. The concentrations of metals were compared by OHM to levels determined from OHM off-site background surface soil samples. Samples taken near Bunkers 302 and 309, had concentrations of several metals above background including antimony, barium, chromium, copper, lead, mercury, nickel, potassium, and zinc. Lead was found at concentrations up to 150 μg/g in all soil samples.

Removals

A drum found in the depression between Bunkers 306 and 309 was removed and staged at Site P16 and a confirmatory soil sample (P16CD1) was collected from the drum location. The sample indicated a high concentration of iron (20,000 μg/g) probably as a result of rusting, as well as the base/neutral/acid extractable organic compounds (BNAs) di-n-butylphthalate (1.1 μg/g), isophorone (0.73 μg/g), mesityl oxide (15 μg/g), and α-pinene (0.022 μg/g). Di-n-butylphthalate is a plasticizer and is often the result of laboratory or field handling. Alpha-pinene is a terpene often found in areas of pine trees and pine down. The isophorone detection is well below the EPA Region III Risk-Based Concentration (RBC) of 670 μg/g. No screening value could be located for mesityl oxide, which is used as a solvent for resins, lacquers, inks, paint, and insect repellent.

1.2.2.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation were analyzed for TCL organics, TAL metals, herbicides, and TOC. In addition, one surface soil was sent for geotechnical analysis to determine grain size distribution. A summary of Phase II Sampling Activities at Site P16 is provided in Table 1-15.

Table 1-15

PHASE II SAMPLING EFFORT AT SITE P16 — CHEMICAL AND WASTE STORAGE BUNKERS

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	12	08/31/93 09/01/93 12/01/93	Samples were collected to characterize the bunkers as potential sources of contamination. One resample based on QC problems.
	1	09/01/93	A geotechnical sample was collected at location E3-P16-S03 to characterize the nature of surface soils.

Source: Ecology and Environment, Inc. 1994.

Surface Soil Sampling

A total of twelve surface soil samples (four from each of three bunkers) were collected from the bunker drain spouts to investigate the potential for contaminant migration. The samples were collected from just below the mouths of the drains and from the drainage runoff channel which is evident below each drain. The samples collected were as follows:

- Bunker 302: E3-P16-S01 through E3-P16-S04;
- Bunker 306: E3-P16-S05 through E3-P16-S08; and
- Bunker 309: E3-P16-S09 through E3-P16-S12.

As a result of QA/QC problems and a scheduling problem, E & E resampled E3-P16-S10 and analyzed the sample for BNAs in December 1993.

1.2.2.7 Nature and Extent of Contamination

A summary of the detections above preliminary screening levels is provided in Table 1-16. Analytical results of samples from Site P16 are presented in the Chemical Summary Report for Surficial Soils, Table 1-17 following Section 1.2.2.8 Conclusions and Recommendations. The principal result of analysis of soil samples taken in the runoff paths from drains at Bunkers 302, 306, and 309, indicated the presence of arsenic (highest

Table 1-16

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P16

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Sample ID	Frequency Above Screen Level
SOILS (μg/g)	Arsenic	10	30	MCP GW-1/S-1[1]	270	E3-P16-S03	7/12
	Benzo(*a*) pyrene	--	0.7	MCP GW-1/S-1	0.850	E3-P16-S08	1/12
	Benzo(*b*) fluoranthene	--	0.7	MCP GW-1/S-1	1.50	E3-P16-S08	4/12
	Chrysene	--	0.7	MCP GW-1/S-1	0.830	E3-P16-S03	3/12
	Indeno (1,2,3-cd) pyrene	--	0.7	MCP GW-1/S-1	0.930	E3-P16-S08	1/12
	Benzo(*g,h,i*) perylene	--	0.7	MCP GW-1/S-1	0.87	E3-P16-S08	1/12
	Pyrene	--	0.7	MCP GW-1/S-1	1.6	E3-P16-S08	1/12

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

concentrations found were 270 μg/g, 98.0 μg/g, and 74.0 μg/g, respectively). In comparison to background soil samples, these concentrations are from seven to 27 times the highest arsenic background level (10 μg/g). The soil screening level of 30 μg/g (MCP GW-S-1 and GW-3/S-3) was exceeded in two out of four samples at Bunker 302, one out of four samples at Bunker 306, and in all four samples at Bunker 309. However, none of the arsenic concentrations detected in P16 soil samples exceeded the EPA Region III RBC for commercial/industrial soils of 310 μg/g.

Analysis of the soil sample data shows that the arsenic concentrations decline as the distance from the bunker drains increases. At each bunker, the soil samples taken immediately below the bunker drain (at E3-P16-S02 and E3-P16-S04 for Bunker 302, at E3-P16-S07 and E3-P16-S08 for Bunker 306, and E3-P16-S09 and E3-P16-S11 for Bunker 309) had higher arsenic levels than soil samples taken in the drainage pathway at the bottom of the slope from the bunkers (Bunker 302 samples at E3-P16-S01 and E3-P16-S02; Bunker 306 samples at E3-P16-S05 and E3-P16-S06; and Bunker 309 samples E3-P16-S10 and E3-P16-S12). This pattern of results is consistent with an arsenic source that is located within each of the three bunkers.

Arsenic was not found at elevated concentrations in earlier soil sampling by OHM at Site P16. In OHM sampling at Bunkers 302, 306, and 309, the highest concentration of arsenic (6.01 μg/g, 6.3 μg/g, and 6.4 μg/g, respectively) were well below the recent E & E results summarized above, and were not above background soil levels.

Other metals found in E & E soil sampling at Site P16, included copper, manganese, nickel, and potassium; these were slightly above background soil levels, but were well below soil screening levels.

Several PAH compounds including benzo(*b*)fluoranthene (1.50 μg/g), benzo(*a*)pyrene (0.850 μg/g), chrysene (0.830 μg/g), benzo(*g,h,i*)perylene (0.87 μg/g), pyrene (1.6 μg/g), and indeno(1,2,3-cd)pyrene (0.930 μg/g) were found in concentrations above the soil screening level for these compounds of 0.7 μg/g (MCP GW-1/S-1; MCP GW-3/S-3). These PAH compounds were found at concentrations above the soil screening levels in the following locations: E3-P16-S03 at Bunker 302, E3-P16-S08 at Bunker 306, and E3-P16-S11, and E3-P16-S12 at Bunker 309. With the exception of the sample at E3-P16-S12, all of the PAH detections above screening levels were in the samples taken closest to the bunker drains. OHM sampling of the three bunkers also found PAH compounds in elevated concentrations, particularly at Bunker 306. The source of these PAHs may be oil, creosote, or spraying of pesticides/oil mixtures.

Numerous pesticides were found in soil samples taken at Site P16 at trace concentrations, but none exceeded soil screening levels. However, maximum concentrations of DDT (1.30 μg/g) and its degradation products DDD (0.360 μg/g) and DDE (0.590 μg/g) were above background soil levels in two out of four samples at Bunker 302, two out of four samples at Bunker 306, and in all four samples from Bunker 309. OHM soil sampling at Site P16 also detected elevated levels of DDT (up to 22 μg/g), DDD (up to 5.3 μg/g), and DDE (up to 3.3 μg/g) at Bunker 309. These compounds were also found in E & E soil sampling at Bunker 309. While the recent E & E results did not indicate any pesticides in concentrations above soil screening levels, the highest DDT, DDE, and DDD concentrations found in OHM's sampling in 1992 did exceed the soil screening levels. The concentration of DDT (22 μg/g) at Bunker 309 found in OHM sampling exceeds the MCP GW-3/S-3 soil level of 9 μg/g and the EPA Region III RBC for commercial/industrial soil of 8.4 μg/g.

No organic compounds, except common lab contaminants, were found in any of the soil samples taken at Site P16.

1.2.2.8 Conclusions and Recommendations

The initial concern at Site P16 was the alleged, past storage of waste chemicals in the bunkers, which could migrate to the surrounding area. Because of the pattern of arsenic detection in soils above soil screening levels outside Bunkers 302, 306, and 309 (described above), arsenic detection seems to be site-related. It is not yet certain whether the arsenic is related to past chemical storage or to some other material previously stored or used in the bunkers. The nature of contamination at these three bunkers remains unclear given the

anomalous arsenic test results. It should also be noted that previous soil sampling in 1992 by OHM did not detect arsenic at concentrations above background soil levels.

No further sampling was conducted in the depression between Bunkers 306 and 309 where several BNAs including mesityl oxide were detected in 1992 in OHM drum confirmation sample P16CD1. To determine whether there is mesityl oxide contamination, soil samples along a 4-point grid around P16CD1 is recommended.

Although the concentrations of PAHs, and DDT and its degradation products DDD and DDE detected in 1992 by OHM appear to have decreased in the 1993 sampling round, the levels of PAHs detected in the recent round of sampling remain above soil screening levels. The declining concentrations of PAHs and pesticides in site soils may indicate that the level of these compounds has been reduced due to degradation or transport off-site.

Since arsenic has been detected above screening levels in soils, at three other nearby bunkers (Bunkers 301, 311, and 312, sampled for the investigation of Site P54), and in Puffer Pond sediments, further investigation of Site P16 and Site P54 bunkers should be made to determine sources and migration patterns of arsenic. The highest detection of arsenic (270 μg/g) in soils at bunkers in Site P16 and Site P54 was at Bunker 302. Thus, it is recommended that investigation be conducted at Bunker 302 as a test case to assess potential bunker-related arsenic contamination at both sites. The specific scope of this investigation is listed below:

- Further soil sampling in the runoff path from Bunker 302 to profile the extent of arsenic contamination;

- Wipe samples taken inside Bunker 302 along the drains to confirm if the bunker is the actual source of the arsenic; and

- Installation of one well at Bunker 302 to assess if arsenic has migrated into groundwater.

All samples should also be tested for PAHs and pesticides to identify any potential migration of these compounds.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

	Site ID	E3-P16-S01	E3-P16-S01	E3-P16-S01	E3-P16-S02	E3-P16-S02	E3-P16-S03
	Field Sample ID	SDP16011	SXP16011	SXP16011	SXP16021	SXP16021	SXP16031
	Sample Date	08/31/93	08/31/93	09/01/93	08/31/93	09/01/93	09/01/93
Test	Parameter .						
TAL METAL	Aluminum	4510	5680		3970		5050
	Antimony	0.439 BJ	0.622 B!		0.734 K!		0.856 K!
	Arsenic	41.0 !@	35.0 !@		15.0 !		270 !@
	Barium	19.5	22.2		14.0		15.6
	Beryllium	0.245 J	0.310 J		0.210 J		0.257 J
	Calcium	718	556		1160		316 J
	Chromium	11.2	13.9		7.95		9.00
	Cobalt	5.07	7.27 !		3.60		3.64
	Copper	9.19	12.3 !		7.10		7.22
	Iron	6790	9380		5920		5640
	Lead	22.0	14.0		61.0		22.0
	Magnesium	1630	2070		1060		1150
	Manganese	140 !	192 !		81.4		76.6
	Mercury	< 0.100	< 0.100		< 0.100		< 0.100
	Nickel	13.7 !	13.8 !		10.8 !		12.0 !
	Potassium	989 !	1120 !		517 K		671 !
	Thallium	< 0.500	< 0.500		< 0.500		0.258 J
	Vanadium	12.9	14.9		10.6		10.1
	Zinc	20.1	23.3		21.2		11.3
TCL BNA	Acenaphthylene	< 0.330	< 0.330		< 0.330		< 0.330
	Anthracene	< 0.330	0.064 J		< 0.330		0.058 J
	BEPYR						0.450
	Benzo(a)anthracene	0.360 J	0.210 J		< 0.330		0.510
	Benzo(a)pyrene	0.240 J	0.190 J		0.080 J		0.410
	Benzo(b)fluoranthene	0.420	0.310 J		0.190 J		0.920 @
	Benzo(ghi)perylene	0.170 J	0.140 J		< 0.330		0.310 J
	Benzo(k)fluoranthene	0.180 J	0.160 J		< 0.330		0.340

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

Test	Site ID	E3-P16-S01	E3-P16-S01	E3-P16-S01	E3-P16-S02	E3-P16-S02	E3-P16-S03
	Field Sample ID	SDP16011	SXP16011	SXP16011	SXP16021	SXP16021	SXP16031
	Sample Date	08/31/93	08/31/93	09/01/93	08/31/93	09/01/93	09/01/93
Test	Parameter						
TCL BNA	Chrysene	0.450	0.310 J		0.130 J		0.830 @
	Dibenzo(a,h)anthracene	< 0.330	< 0.330		< 0.330		< 0.330
	Fluoranthene	0.600	0.540		0.180 J		1.50
	Indeno(1,2,3-cd)pyrene	0.150 J	0.130 J		0.081 J		0.390
	LINOLA						
	NCHRYS	0.140	0.091				
	Naphthalene	< 0.330	< 0.330		< 0.330		< 0.330
	OPDDT				0.500		
	PAH		0.350				
	Phenanthrene	0.055 J	0.280 J		< 0.330		0.260 J
	Pyrene	0.580	0.500		0.150 J		1.20
TCL Pest	Aldrin	0.001 JU	0.001 JC		< 0.002		< 0.002
	Dieldrin	0.013 KU	0.005 BU		0.023 UK		0.015 U
	Endrin	< 0.002	< 0.002		< 0.002		< 0.002
	Heptachlor Epoxide	0.001 JC	< 0.002		0.002 C!		0.002 BJC!
	P,P-DDD	0.015 JC	0.005 JC		0.230 C!		0.016 U
	P,P-DDE	0.018 JC	0.007 KC		0.040 C		0.014 C
	P,P-DDT	0.053 JC	0.017 JC		0.950 C!		0.049 C
	alpha-BHC	< 0.002	0.002 U		< 0.002		0.003 U
TOC	Total Organic Carbon	14100 J	6560 J		17500		10300

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low. # = Exceeds ecological screening value
K= Result bias high. R= Result rejected. @= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

Test	Parameter	E3-P16-S04	E3-P16-S05	E3-P16-S05	E3-P16-S06	E3-P16-S06	E3-P16-S07
	Field Sample ID	SXP16041	SXP16051	SXP16051	SXP16061	SXP16061	SXP16071
	Sample Date	09/01/93	08/31/93	09/01/93	08/31/93	09/01/93	09/01/93
TAL METAL	Aluminum	3830	4030		4720		3750
	Antimony	0.635 B!	0.376 BJ		0.481 BJ		0.431 BJ
	Arsenic	26.0 !	10.1 !		17.0 !		13.0 !
	Barium	15.0	16.1		15.1		14.7
	Beryllium	0.230 J	0.224 J		0.230 J		0.212 J
	Calcium	2580 !	383 J		399 J		375 J
	Chromium	8.10	9.01		11.3		8.08
	Cobalt	4.18	5.54		5.85		4.60
	Copper	8.39	9.92		10.9 !		7.80
	Iron	5280	6270		7070		4810
	Lead	140	14.0		12.0		28.0
	Magnesium	875	1440		1720		1010
	Manganese	102 !	154 !		131 !		128 !
	Mercury	< 0.100	< 0.100		< 0.100		< 0.100
	Nickel	12.4 !	16.2 !		12.9 !		11.7 !
	Potassium	449 K	771 !		930 !		570 K
	Thallium	< 0.500	< 0.500		< 0.500		< 0.500
	Vanadium	10.6	9.57		11.7		9.23
	Zinc	25.8	17.7		17.8		16.6
TCL BNA	Acenaphthylene	< 0.330	< 0.330		< 0.330		< 0.330
	Anthracene	< 0.330	< 0.330		< 0.330		< 0.330
	BEPYR	0.230					
	Benzo(a)anthracene	0.180 J	< 0.330		< 0.330		< 0.330
	Benzo(a)pyrene	0.170 J	< 0.330		< 0.330		< 0.330
	Benzo(b)fluoranthene	0.350	< 0.330		< 0.330		0.030 J
	Benzo(ghi)perylene	0.100 J	< 0.330		< 0.330		< 0.330
	Benzo(k)fluoranthene	0.093 J	< 0.330		< 0.330		< 0.330

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
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# = Exceeds ecological screening value
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Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

	Site ID	E3-P16-S04	E3-P16-S05	E3-P16-S05	E3-P16-S06	E3-P16-S06	E3-P16-S07
	Field Sample ID	SXP16041	SXP16051	SXP16051	SXP16061	SXP16061	SXP16071
	Sample Date	09/01/93	08/31/93	09/01/93	08/31/93	09/01/93	09/01/93
Test	Parameter .						
TCL BNA	Chrysene	0.280 J	< 0.330		< 0.330		< 0.330
	Dibenzo(a,h)anthracene	< 0.330	< 0.330		< 0.330		< 0.330
	Fluoranthene	0.470	< 0.330		< 0.330		< 0.330
	Indeno(1,2,3-cd)pyrene	0.120 J	< 0.330		< 0.330		< 0.330
	LINOLA				0.087		
	NCHRYS						
	Naphthalene	< 0.330	< 0.330		< 0.330		< 0.330
	OPDDT						
	PAH						
	Phenanthrene	0.150 J	< 0.330		< 0.330		< 0.330
	Pyrene	0.380	< 0.330		< 0.330		0.026 J
TCL Pest	Aldrin	< 0.002	0.001 JC		0.002 JC		0.001 JC
	Dieldrin	0.009 KU	0.002 BJU		0.001 BJU		0.003 BU
	Endrin	0.006 KU	0.002 C		0.001 JU		0.001 BJU
	Heptachlor Epoxide	0.004 BC!	0.001 JU		0.001 JU		0.001 BJC
	P,P-DDD	0.320 C!	0.004 C		0.005 U		0.024 C
	P,P-DDE	0.590 C!	0.009 KC		0.006 KC		0.150 C!
	P,P-DDT	0.110 C	0.006 KC		0.016 C		0.130 C
	alpha-BHC	0.003 U	< 0.002		< 0.002		0.003 C
TOC	Total Organic Carbon	23900	6120		7580		9640

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

\# = Exceeds ecological screening value

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

	Site ID	E3-P16-S08	E3-P16-S09	E3-P16-S10	E3-P16-S10	E3-P16-S10	E3-P16-S11
	Field Sample ID	SXP16081	SXP16091	SDP16102	SXP16101	SXP16102	SXP16111
	Sample Date	09/01/93	09/01/93	12/01/93	09/01/93	12/01/93	09/01/93
Test	Parameter .						
TAL METAL	Aluminum	6700	7180		7330		7490
	Antimony	1.24 K!	0.517 B!		0.303 BJ		0.539 B!
	Arsenic	98.0 !@	57.0 !@		45.0 !@		74.0 !@
	Barium	16.5	22.0		24.2		18.7
	Beryllium	0.300 J	0.334 J		0.294 J		0.308 J
	Calcium	389 J	1600 !		827		505 J
	Chromium	13.1	14.5 !		14.2		14.8 !
	Cobalt	7.40 !	7.41 !		6.01		6.07
	Copper	14.4 !	18.3 !		10.8 !		9.01
	Iron	13000 !	12000		10200		11000
	Lead	27.0	49.0		24.0		19.0
	Magnesium	2170	2300		2420 !		2670 !
	Manganese	168 !	204 !		156 !		126 !
	Mercury	< 0.100	0.084 J		0.084 J		0.107
	Nickel	11.8 !	13.3 !		11.1 !		11.1 !
	Potassium	846 !	778 !		1020 !		1020 !
	Thallium	0.194 J	0.118 J		< 0.500		0.128 J
	Vanadium	14.9	18.1		16.8		17.3
	Zinc	62.0 J!	40.6 J		28.5 J		24.1 J
TCL BNA	Acenaphthylene	0.075 J	< 0.330	< 0.330	< 0.330	< 0.330	< 0.330
	Anthracene	0.140 J	< 0.330	< 0.330	< 0.330	< 0.330	0.081 J
	BEPYR	1.20					
	Benzo(a)anthracene	0.400	< 0.330	< 0.330	< 0.330	< 0.330	0.240 J
	Benzo(a)pyrene	0.850 @	< 0.330	< 0.330	< 0.330	< 0.330	0.420
	Benzo(b)fluoranthene	1.50 @	0.099 J	< 0.330	< 0.330	0.057 J	0.950 @
	Benzo(ghi)perylene	0.870	< 0.330	< 0.330	< 0.330	< 0.330	0.460
	Benzo(k)fluoranthene	0.340	< 0.330	< 0.330	< 0.330	< 0.330	0.330 J

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

= Exceeds ecological screening value

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

Test	Site ID	E3-P16-S08	E3-P16-S09	E3-P16-S10	E3-P16-S10	E3-P16-S10	E3-P16-S11
	Field Sample ID	SXP16081	SXP16091	SDP16102	SXP16101	SXP16102	SXP16111
	Sample Date	09/01/93	09/01/93	12/01/93	09/01/93	12/01/93	09/01/93
Test	Parameter						
TCL BNA	Chrysene	0.810 @	0.070 J	< 0.330	< 0.330	< 0.330	0.530
	Dibenzo(a,h)anthracene	0.200 J	< 0.330	< 0.330	< 0.330	< 0.330	0.110 J
	Fluoranthene	0.990	0.074 J	< 0.330	< 0.330	0.080 J	0.620
	Indeno(1,2,3-cd)pyrene	0.930 @	0.063 J	< 0.330	< 0.330	< 0.330	0.470
	LINOLA						
	NCHRYS						
	Naphthalene	0.072 J	< 0.330	< 0.330	< 0.330	< 0.330	< 0.330
	OPDDT						
	PAH						
	Phenanthrene	0.210 J	< 0.330	< 0.330	< 0.330	< 0.330	0.170 J
	Pyrene	1.60	0.089 J	< 0.330	< 0.330	< 0.330	0.850
TCL Pest	Aldrin	0.001 JU	0.001 JC		0.001 JU		0.003 U
	Dieldrin	0.016 C	0.004 BU		0.004 BU		0.014 U
	Endrin	< 0.002	0.005 KU		0.004 BU		< 0.002
	Heptachlor Epoxide	0.001 BJU	0.003 BU!		0.001 BJU		0.001 BJU
	P,P-DDD	0.087 C!	0.096 C!		0.100 C!		0.290 C!
	P,P-DDE	0.038 C	0.360 C!		0.370 C!		0.400 C!
	P,P-DDT	0.270 C!	0.540 C!		0.480 C!		1.30 C!
	alpha-BHC	< 0.002	0.003 U		< 0.002		0.003 U
TOC	Total Organic Carbon	16100	19000		20100		11600

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

Test	Parameter	E3-P16-S12					
	Field Sample ID	SXP16121					
	Sample Date	09/01/93					
TAL METAL	Aluminum	6350					
	Antimony	0.626 B!					
	Arsenic	53.0 !@					
	Barium	20.8					
	Beryllium	0.271 J					
	Calcium	736					
	Chromium	12.7					
	Cobalt	5.78					
	Copper	8.88					
	Iron	9290					
	Lead	29.0					
	Magnesium	1990					
	Manganese	146 !					
	Mercury	0.085 J					
	Nickel	9.14					
	Potassium	1090 !					
	Thallium	< 0.500					
	Vanadium	16.0					
	Zinc	34.4 J					
TCL BNA	Acenaphthylene	< 0.330					
	Anthracene	0.097 J					
	BEPYR						
	Benzo(a)anthracene	0.290 J					
	Benzo(a)pyrene	0.480					
	Benzo(b)fluoranthene	1.40 @					
	Benzo(ghi)perylene	0.540					
	Benzo(k)fluoranthene	0.380					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-17
Chemical Summary Report For Surficial Soils
Site: P16
Units: UGG

	Site ID	E3-P16-S12					
	Field Sample ID	SXP16121					
	Sample Date	09/01/93					
Test	Parameter .						
TCL BNA	Chrysene	0.820 @					
	Dibenzo(a,h)anthracene	0.130 J					
	Fluoranthene	0.930					
	Indeno(1,2,3-cd)pyrene	0.660					
	LINOLA						
	NCHRYS						
	Naphthalene	< 0.330					
	OPDDT						
	PAH						
	Phenanthrene	0.220 J					
	Pyrene	1.20					
TCL Pest	Aldrin	0.001 JU					
	Dieldrin	0.025 U!					
	Endrin	< 0.002					
	Heptachlor Epoxide	0.004 BU!					
	P,P-DDD	0.360 C!					
	P,P-DDE	0.370 C!					
	P,P-DDT	1.30 C!					
	alpha-BHC	0.003 U					
TOC	Total Organic Carbon	17400					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

1.2.3 Site P27 — Pyrotechnics Test Area

Site P27 was identified through review of an undated map of the Annex (which is believed to be from the Maynard Ordnance Test Station (MOTS) period that took place from 1952 to 1957). The map was among other materials used in the preparation of U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Report 170 (USATHAMA 1980). This report identified the area as "Test Area No. 3, Pyrotechnics." Figure 1-4 depicts the exact layout of Site P27.

1.2.3.1 Site Location

Site P27 lies on the northeastern side of Patrol Road about 2,000 feet west of the east gate. Site P27 is most easily accessed by crossing the fence between power poles marked 18 and 21 along Patrol Road. Beyond the fence there is a clear area with several scattered trees. Immediately southeast of this first clear area, there is a second cleared area which is slightly larger in size. About 150 feet into the treeline and north of the first cleared area, there is a slight depression bordered by a berm and a stone wall on its northern and eastern sides. The entire depression area is covered with short, dense shrubs.

1.2.3.2 Physical Characteristics

Site P27 is located on glacial outwash sand and gravel underlain at shallow depth by till (ground moraine) and adjoining a wetland immediately to the west. The surface elevation at the site is approximately 185 feet AMSL. No subsurface exploration occurred at this location, however, grain size and Atterberg limits analyses performed on surface soil sample E3-P27-S01 identified the surface soil in the area as non-plastic, silty sand with gravel. Appendix D contains a summary of geotechnical results. Depth to bedrock is also unknown but may be shallow because bedrock outcrops occur approximately 400 feet east of the site. They consist of amphibolitic schist of the Marlboro Formation.

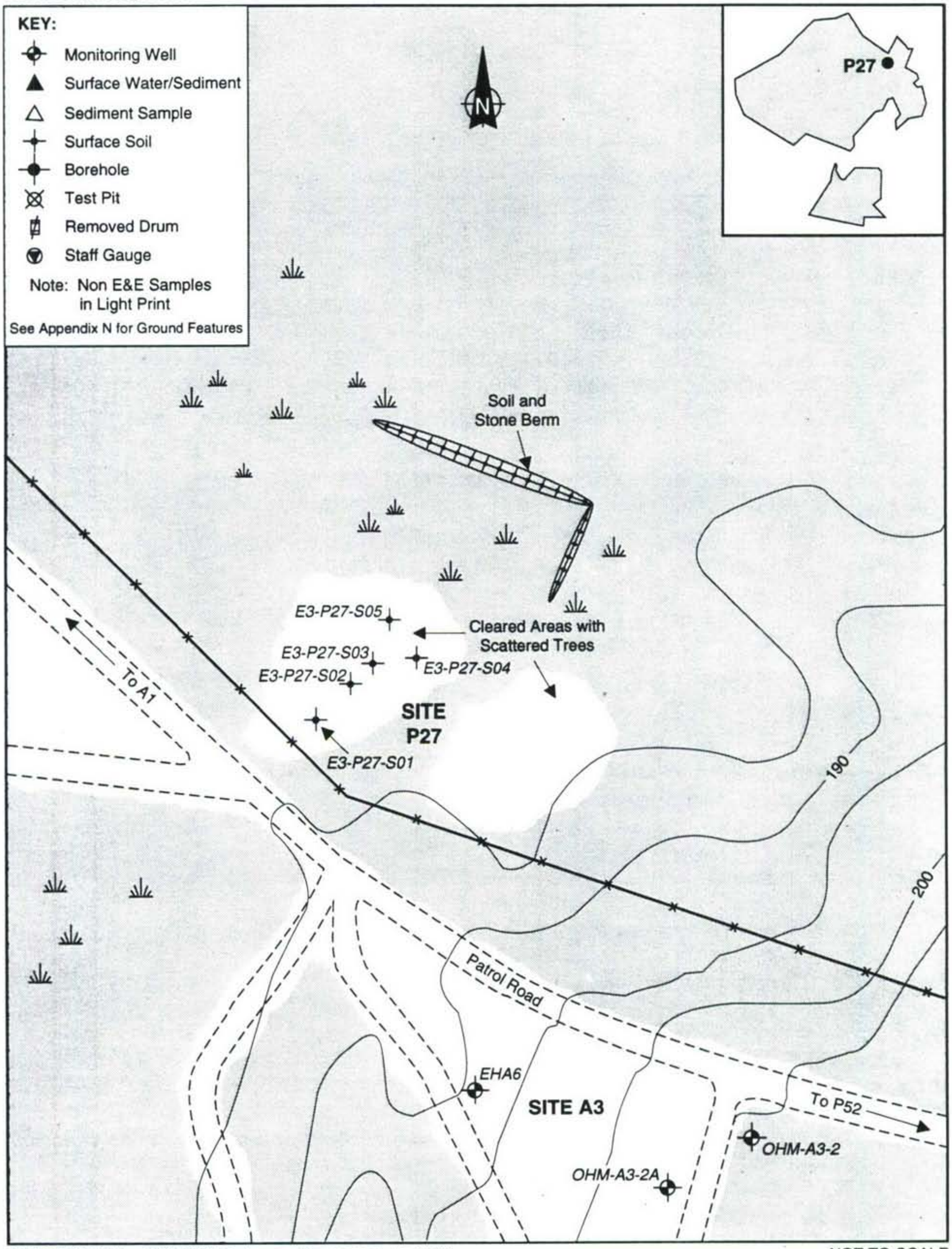
Surface water flow from the site is west to the wetland which ultimately drains to Taylor Brook. No wells were installed at Site P27, but topography and drainage patterns indicate that groundwater is less than 20 feet BGS in this area, and flow is northwest to the adjoining wetland.

1.2.3.3 Ecological Characterization

Site P27 was used as a pyrotechnics testing area. The site consists of two partially cleared areas vegetated with various grasses and forbs surrounded by a dense, white pine and hardwood forest with trees ranging from 40 to 60 feet in height (LFS 1983).

Based on the site's general topography, surface water runoff flows west towards two wetlands. The first wetland, located approximately 200 feet to the north-northwest, is a large area vegetated with deciduous trees and scrubs. The second wetland, located approximately 400 feet south-southwest, is a former agricultural field which has reverted to a wetland (USDOI 1977).

11: SUDBURY\UC6_P27.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-4 MAP OF SITE P27 PYROTECHNICS TEST AREA

In general, this area combines a variety of productive habitats: upland forest, open area, and forested wetland. White pine and hardwood trees provide both roosting and nesting sites for songbirds and gamebirds while also providing cover for various mammals. Pine seeds, buds, needles, and twigs are consumed by various species of wildlife, small mammals and deer (Martin *et al.* 1951). The two open areas at the site support a distinct forest edge community of birds and mammals that depend on both forested and open areas. Finally, forested wetlands combine an abundance of nutrients, the presence of diverse woody species, and the availability of water to support a diverse array of aquatic, semi-aquatic, as well as upland species.

No unique habitats have been identified near the site (NHESP 1992). Similarly, no rare, threatened or endangered species are known to occur in the area.

1.2.3.4 Site History

Site P27 was identified from an undated map, possibly from the MOTS period (1952 to 1957) (USATHAMA 1980). This map identified the area as the location of "Test Area No. 3, Pyrotechnics." No other references were found that described the exact nature of the tests conducted at this area or confirmed activities for the area. The probable dates for any activities would have been between 1952 and 1957.

A 1944 facility map noted two buildings at the site later identified in a 1955 facility map as Building T425 and Building T427, with Buildings T424, T426, and T428 nearby. These buildings were described in a 1959 memo as follows: T425–dwelling; T427–hen house; T424/T426–poultry houses; and T428–hen house. These structures were demolished around 1959 and were not noted on a 1962 map of the Annex. It is likely that all of these structures were part of a preexisting farm at the time the Army assumed the land in the early 1940s. Whether or not these structures were used as part of a pyrotechnic testing program is unknown.

A 1958 memo from the commander of the Quartermaster Research and Development Center Command at Natick noted the tentative assignment of T426 to the Food Division of the Food and Container Division of the Quartermaster Command for use as an animal farm and laboratory facilities (US Army Quartermaster Research and Engineering Command 1958b). Natick Real Property Records indicated that this development at T426 never occurred, with T426 being demolished around 1959. Instead, limited animal facilities were constructed at Building T452 at the Annex, and the animal laboratory itself was established at Natick as part of the Center Laboratories.

1.2.3.5 Results of Previous Investigations

In 1984, Dames and Moore collected a surface water and sediment sample from a stream 400 feet northwest of Site P27. Both samples were tested for the presence of VOCs, BNAs, TAL metals, and phosphates. It was stated that no levels above background were not detected in either the surface water or the sediment.

A record search also conducted by Dames and Moore did not find any evidence supporting the use of explosives, pyrotechnics, or rockets in the area.

In 1991, OHM conducted an Enhanced Area Reconnaissance of the areas including Site P27 and the adjacent Site P52. During this survey, two concrete slabs, scrap metal, and a drum were located. These findings were reported as part of Site P27 reconnaissance in January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). Review of aerial photographs suggests that they belong to Site P52. Consequently, these results have been presented as part of the discussions of investigations to date at Site P52.

1.2.3.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation were analyzed for TCL organics, TAL metals, and explosives. In addition, one of the surface soil samples was sent for geotechnical analysis to determine grain size distribution. A summary of Phase II Sampling Activities at Site P27 is provided as Table 1-18.

Table 1-18

PHASE II SAMPLING EFFORTS AT SITE P27 — PYROTECHNICS TEST AREA

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	5	08/30/93	Samples were collected to investigate the presence of site contamination due to past activities.
	1	08/30/93	A geotechnical sample was collected to characterize the nature of surface soils.

Source: Ecology and Environment, Inc. 1994.

Surface Soil Sampling

A total of five samples were collected for chemical analysis from five locations chosen based on the presence of obvious soil discoloration, stressed vegetation, or apparent surface drainage pathways. One of the samples, E3-P27-S01, was analyzed for grain size distribution.

1.2.3.7 Nature and Extent of Contamination

A summary of the detections above preliminary screening levels is provided in Table 1-19. In addition, chemical summary reports for all samples collected at Site P27 are provided in Table 1-20 following the Section 1.2.3.8, Conclusions and Recommendations. Analysis of surface soil samples at Site P27 indicated arsenic concentrations in soils elevated between 17 and 50 times the highest level of arsenic detected in background soils. At the site, the lowest concentration of arsenic found in soil samples was 200 μg/g and the highest

Table 1-19

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P27

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Sample ID	Frequency Above Screen Level
SOIL (μg/g)	Arsenic	10	30	MCP GW-1/S-1[1]	550	E3-P27-S01	5/5

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

was 550 μg/g, which was the third highest arsenic detection in E & E soil sampling at the Annex. All of the arsenic concentrations found in the soil were at least six times the soil screening level of 30 μg/g (MCP GW-1/S-1 and MCP GW-3/S-3). Four out of five soil samples at the site also had arsenic concentrations above the EPA Region III RBC for Commercial/Industrial Soils of 310 μg/g. The consistency of these results raises the possibility that these may be natural levels, although unusually high, implying local mineralized sources in the bedrock, but this hypothesis cannot be confirmed without further investigation.

In one sample, at E3-P27-S05, the concentration of iron (96,000 μg/g) was approximately eight times the highest level found in background samples, but the other four soil samples had concentrations near background levels. Antimony and potassium concentrations in the soil samples were also up to three times the highest level found in background soil samples, but did not exceed soil screening levels. Other metals detected at the site including barium, chromium, cobalt, copper, magnesium, manganese, and nickel were also slightly elevated above background, with none of the highest concentrations detected at the site exceeding twice the background levels.

No VOCs or explosives were found in soil samples taken at this site. A trace concentration of a PAH compound, fluoranthene (up to 0.069 μg/g) was found in two samples. Trace concentrations of several pesticides were also found, but were below any soils screening levels. The highest confirmed concentrations of DDT (0.650 μg/g) and DDE (0.410 μg/g) were slightly above levels found in background samples but below the soil screening level of 2 μg/g (MCP GW-1/S-1), and the MCP GW-3/S-3 soil level of 9 μg/g.

1.2.3.8 Conclusions and Recommendations

The arsenic detected in soils at Site P27 may indicate soil contamination from site activities in the northwestern clearing. This clearing was sampled due to the undated map which identified the area as a pyrotechnics test area. Some low concentrations of DDT were also found in soils at the site, but may be related to general pesticide use at the Annex rather

than site-specific activity. The exact source of the arsenic at the site is unknown, although potential sources could include natural levels of arsenic, arsenic constituents of pyrotechnics that may have been tested at the site, or arsenic-based herbicides or other compounds used either at the Annex or in farming activities conducted at the site prior to the Army's assumption of the land in the early 1940's.

It is recommended that further investigation be conducted to profile the extent of arsenic related to this site. Specific recommended actions are noted below:

- Soil sampling in the runoff path from the western clearing to identify if any arsenic is migrating toward the adjacent wetland area;

- Soil sampling in the eastern clearing to identify if arsenic contamination is also present;

- Soil sampling upgradient of the site to establish local background levels of arsenic;

- Surface water and sediment sampling of the wetland adjacent to the site;

- Installation of two downgradient wells to see if arsenic has affected groundwater; and

- Research into arsenic constituents of pyrotechnics and arsenic-based herbicides used in farming to attempt to clarify the potential source of the arsenic at the site.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-20
Chemical Summary Report For Surficial Soils
Site: P27
Units: UGG

Test	Parameter	E3-P27-S01	E3-P27-S02	E3-P27-S03	E3-P27-S04	E3-P27-S05
	Field Sample ID	SXP27011	SXP27021	SXP27031	SXP27041	SXP27051
	Sample Date	08/30/93	08/30/93	08/30/93	08/30/93	08/30/93
TAL METAL	Aluminum	9950	7810	7450	6290	8140
	Antimony	1.80 !	1.78 !	1.52 !	0.843 K!	1.62 !
	Arsenic	550 !@	540 !@	380 !@	200 !@	500 !@
	Barium	24.2	29.6 !	23.3	31.8 !	20.2
	Beryllium	0.337 J	0.373 J	0.319 J	0.284 J	0.336 J
	Calcium	313 J	< 500	603	494 J	303 J
	Chromium	21.2 !	17.4 !	14.8 !	15.8 !	13.8
	Cobalt	8.32 K!	6.61 !	7.15 !	5.79	5.79
	Copper	14.5 !	18.1 !	11.4 !	12.8 !	10.7
	Iron	13000 !	12000	10100	11000	96000 !
	Lead	18.0	23.0	7.23	12.0	14.0
	Magnesium	3020 !	2480 !	2460 !	2610 !	2190
	Manganese	102 !	94.3	103 !	103 !	86.0
	Nickel	14.3 !	12.1 !	10.7	9.78	13.2 !
	Potassium	1390 !	1540 !	1470 !	2000 !	1060 !
	Selenium	0.243	0.277	< 0.200	< 0.200	0.286
	Thallium	< 0.500	0.130 J	< 0.500	0.143 J	< 0.500
	Vanadium	26.0	23.3	17.8	22.2	18.7
	Zinc	23.5 K	17.5	19.1	19.9	17.4
TCL BNA	Fluoranthene	0.063 J	0.069 J	< 0.330	< 0.330	< 0.330
TCL Pest	P,P-DDE	0.410 C!	0.800 U!	0.064 C	0.080 C	0.097 C
	P,P-DDT	0.650 C!	2.00 U!	0.100 C	0.170 C	0.099 C

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

1.2.4 Site P41 — Bunker 303 Pesticide/Herbicide Storage

Site P41 (Bunker 303) was identified through 1979 interviews with Natick employees regarding disposal and storage of chemical wastes at the Annex (USATHAMA 1980). These interviews stated that Bunker 303 was used for pesticide and herbicide storage. Figure 1-5 presents a map of Site P41.

1.2.4.1 Site Location

This bunker is situated about 800 feet from the southwestern corner of Puffer Pond. The bunker's front faces a paved road and a forest extends around the southern and eastern sides of the bunker. No metal debris or drums were found in the area around the bunker.

Bunkers 302, 306, and 309, which make up Site P16, are located northwest of Bunker 303 in the next line of bunkers. Bunkers 305, 307, and 314, which make up Site P54, are located northwest, northeast, and north, respectively, of Bunker 303.

1.2.4.2 Physical Characteristics

Site P41 occupies a flat area of glacial outwash sand and gravel, near the foot of a ground moraine, or hill of glacial till, that emerges to the south of the site. Surface elevation at the site is approximately 207 feet AMSL. No subsurface exploration occurred, however, a grain size and Atterberg limits analyses performed on surface soil sample E3-P41-S06 identified the surface soil as non-plastic silty sand with gravel. Appendix D contains a complete summary of geotechnical results. Depth to bedrock is unknown but, the underlying bedrock is projected to be the Marlboro Formation (Hansen 1956).

Surface water flows northeast from the site into Puffer Pond. No wells were installed at Site P41, but based on topography and drainage, groundwater is probably less than 20 feet BGS in this area, and flow is northeast towards Puffer Pond.

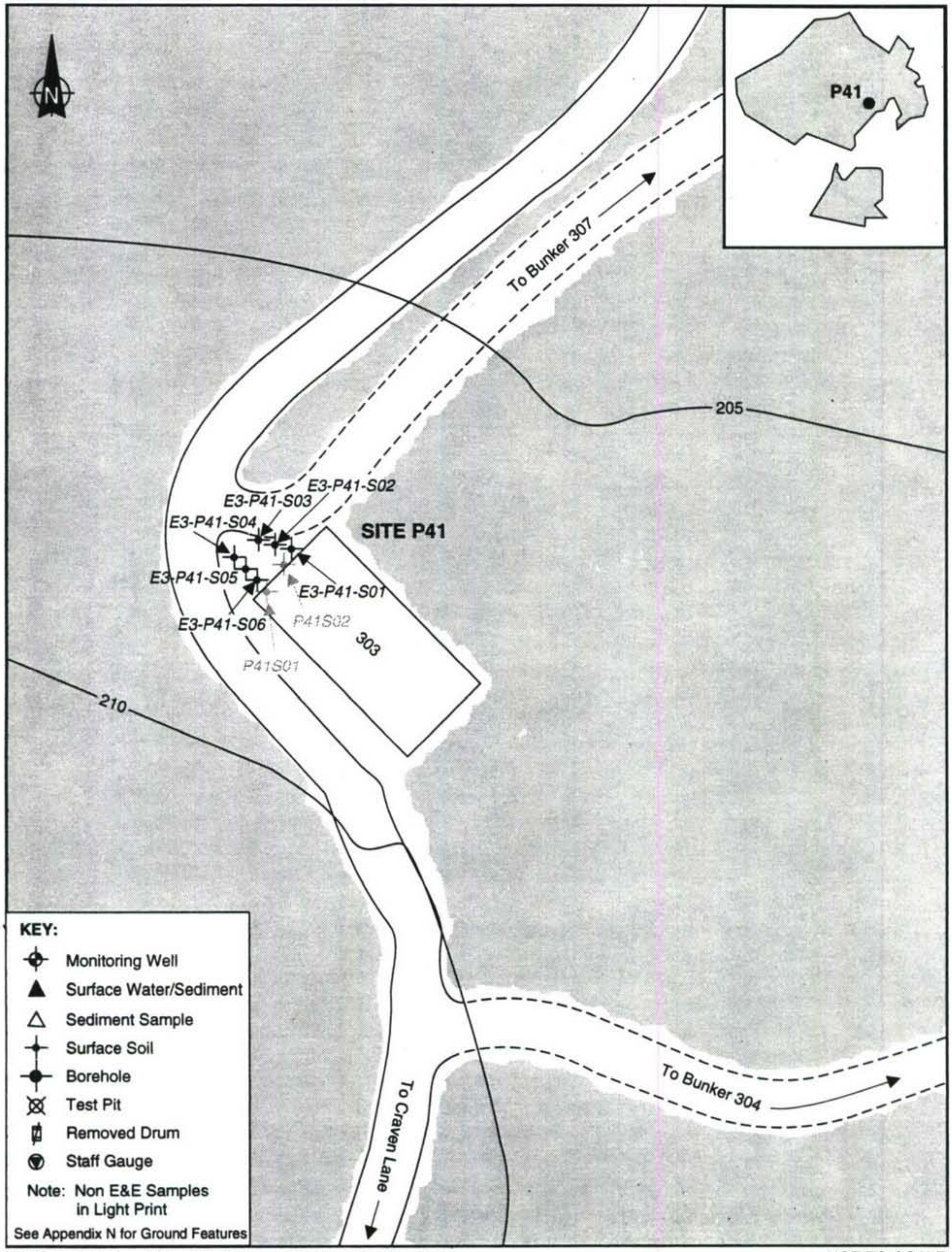
1.2.4.3 Ecological Characterization

Bunker 303 is surrounded by a dense, white pine and oak forest with trees ranging from 40 to 60 feet in height (LFS 1983).

Based on the general topography of this area, surface water runoff from the site flows in a northeasterly direction towards Puffer Pond. Therefore, Puffer Pond, a large body of water associated with the Upper Taylor Brook system, becomes a potential receptor. Because of the well drained soils and low slopes, surface runoff probably occurs only during snowmelt when the ground is frozen or during exceptional storms.

This area provides two types of habitat: upland forest and open water. Pines and oaks are very valuable to wildlife because they provide pine seeds and oak acorns which constitute a major part of the diet of many species of songbirds, upland gamebirds, small mammals, and deer (Martin *et al.* 1951). The dense canopy closure of this type of

11: SUDBURY\UC6_P41.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-5 MAP OF SITE P41
BUNKER 303 - PESTICIDE/HERBICIDE STORAGE

forest also serves as cover for wildlife during the winter. Large bodies of water like Puffer Pond are used by many semi-aquatic and aquatic species as well as by upland species which frequent the area for drinking water. Consequently, amphibians, reptiles, fish, and waterfowl may all be observed in this area. In addition, piscivorous birds and raptors are likely to dive for fish in the deeper parts of Puffer Pond.

No unique habitats are associated with the site (NHESP 1992). However, during an E & E site visit conducted in November 1993, an osprey (*Pandion haliaeetus*) and great blue heron (*Ardea herodius*), both state watch-list species, were observed feeding in Puffer Pond.

1.2.4.4 Site History

Interviews with Natick Laboratory employees (Interviews 1979; Interview undated) and periodic bunker inventories indicate that Bunker 303 was used for the storage of pesticides and herbicides by the Natick Laboratory facility engineer. Bunker 303 was used by the Natick Engineer's Office in 1964. A 1973 inspection listed the use of the bunker by the facility engineer as "the storage of fertilizer and related materials." Ureabor, a herbicide, was used for vegetation control at the fence line of the Annex and was stored in Bunker 303. The 1977 Natick Environmental Assessment recorded that nearly three hundred 50-pound bags of Ureabor were stored in the bunker. At the time of the 1977 inspection, bags were found ripped open and a considerable amount of material had spilled on the floor. The 1980 assessment noted that only seventy 50-pound bags of Ureabor and eight 55-gallon drums of 20 percent DDT/oil solution were stored in the bunker (USATHAMA 1980). A 1982 inspection, though unable to view the bunker interior due to a missing key, noted the storage of weed killer (presumably the Ureabor) and fence posts. In 1992, an inspection reported that nearly 200 bags of Ureabor were stored on pallets and covered with plastic sheeting. Many bags were open and contents were spilled on the floor and in the drain canal along a side wall. No drums of DDT/oil mixture were noted and the fate of drums of this mixture stored in the bunker in 1980 is unknown. Miscellaneous equipment was also being stored in the bunker.

Ureabor is a water soluble non-specific herbicide, containing 66.5 percent sodium metaborate tetrahydrate, 30 percent sodium chlorate, and one and a half percent bromacil. The boron content is 10.44 percent and the bromine content is 0.46 percent (by weight). Either boron or bromine could have been used to identify Ureabor residues, but its mobility allows it to move quickly into the ground and into groundwater, and it does not persist in surface soils exposed to the weather.

In May 1992, the Ureabor was repacked into Type 17H open head drums by Natick's HAZMAT team, and plans were made to excess the material through the DRMO office at Fort Devens. In September 1992, 29 55-gallon drums and nine 30-gallon drums of Ureabor were manifested as a "nonregulated" material and transported to Laidlaw Environmental Services (Northeast), Inc. of Lawrence, Massachusetts (Fort Devens 1992).

1.2.4.5 Results of Previous Investigations

An SI was performed at Site P41 by OHM in 1992. Results of this investigation are described in Section 7 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). The investigation consisted of a reconnaissance of the interior and exterior of the bunker, and surface soil sampling of the area around the two drains of the bunker.

Soil samples were tested for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, TAL metals, explosives, and chlorinated herbicides. Due to the age of the Ureabor, OHM was unable to determine the exact chemical formulation of the Ureabor left at the site. Thus, no method for the specific detection of Ureabor, a potential contaminant in the area, was identified at the time (OHM 1993a).

No chlorinated herbicides were detected. However, several TCL pesticides were present in the soil around the bunker drains. In particular, DDT was found at concentrations up to 30 μg/g. Metals (including barium, cadmium, chromium, copper, lead, mercury, and zinc) were all found at elevated concentrations when compared to the levels determined for background soils. Cadmium (up to 55 μg/g) was particularly high in site soil samples.

1.2.4.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation were analyzed for TCL pesticides/PCBs, TAL metals, and herbicides. One of the surface soil samples collected was sent for geotechnical analysis to determine grain size distribution. A summary of Phase II Sampling Activities at Site P41 is provided as Table 1-21.

Table 1-21

PHASE II SAMPLING EFFORTS AT SITE P41 — BUNKER 303 PESTICIDE/HERBICIDE STORAGE

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	6	09/14/93 12/01/93	Samples were collected to investigate whether past storage activities at the bunker have caused soil contamination.
	1	09/14/93	A geotechnical sample was collected to characterize the nature of the soils.

Source: Ecology and Environment, Inc. 1994.

Surface Soil Sampling

A total of six samples were collected from the two drains and their corresponding drainage channels on either side of the metal door of Bunker 303. Because herbicides were added as a contaminant of concern for P41 after the six samples were initially collected on 14 September 1993, a second set of six samples was collected on 1 December 1993, and

analyzed for herbicides. One of the samples, E3-P41-S06, was analyzed for grain size distribution.

1.2.4.7 Nature and Extent of Contamination

A summary of the detects above preliminary screening levels is provided in Table 1-22. Additionally, a chemical summary report for all samples collected at Site P41 is provided in the chemical summary information found in Table 1-23 following Section 1.2.4.8, Conclusions and Recommendations. The presence of pesticides, in particular DDT and its degradation products, was confirmed in analysis of six soil samples taken immediately outside Bunker 303. DDT, DDD, and DDE were highest in the samples taken at the foot of the slope from the southwestern drain from the bunker, and in the sample taken approximately 15 feet northwest in the runoff path from this same drain. These results indicate that the flow of material containing DDT and its degradation products may collect at the foot of the slope down from the bunker drains, thus increasing concentrations at that point. The maximum concentration of DDT (59.0 μg/g) was well above the soil screening level of 2 μg/g (MCP GW-1/S-1), the MCP GW-3/S-3 soil level of 9 μg/g, and also the EPA Region III RBC for commercial/industrial soils of 8.4 μg/g. The maximum concentration of DDD (30.0 μg/g) also exceeded the soil screening level of 2 μg/g (MCP GW-1/S-1), the MCP GW-3/S-3 soil level of 10 μg/g and the EPA Region III RBC for commercial/industrial soils at 12 μg/g. The maximum level of DDE (3.40 μg/g) only exceeded the soil screening value of 2 μg/g (MCP GW-1/S-1).

Table 1-22

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P41

Medium (Units)	Compound	Maximum Background	Screen Level	Source	Maximum Concentration	Sample ID	Frequency Above Screen Level
SOIL (μg/g)	DDD	0.063	2	MCP GW-1/S-1[1]	30.0	E3-P41-S05	2/6
	DDE	0.139	2	MCP GW-1/S-1[1]	3.40	E3-P41-S05	2/6
	DDT	0.233	2	MCP GW-1/S-1[1]	59.0	E3-P41-S05	2/6

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

Other pesticides were also detected in the soil samples, with endrin, heptachlor epoxide, δ-chlordane, and γ-chlordane present in some of the samples in concentrations above the highest level found in background soil samples. However, none of these pesticides were found at values above soil screening levels.

Chlorinated herbicides were not detected in the soil samples around this bunker. Metals, including arsenic, cadmium, chromium, cobalt, copper, manganese, nickel, and zinc, were found at concentrations above background soil levels. The highest concentration detected in E & E sampling for cadmium (1.98 μg/g) was significantly below the highest

concentration in previous sampling by OHM (55 μg/g). None of the metal concentrations found during E & E samplings were elevated above screening soil values.

1.2.4.8 Conclusions and Recommendations

Historical records state that herbicides and insecticides (including DDT) were stored in Bunker 303. Previous sampling by OHM in 1992, and by E & E in 1993 identified elevated levels of DDT and its degradation products in the soil immediately northwest of the bunker. While herbicides were stored in the bunker, chlorinated herbicides have not been detected in the soils outside the bunker in the analysis of previous and recent soil sampling. To investigate whether Ureabor contamination exists, boron is recommended as an analyte of concern for future investigation at the site.

Given the historical presence of insecticides, the confirmation of insecticides in adjacent soils at levels above screening values, and the proximity of the site to Puffer Pond, further site investigation is recommended. Specific recommended actions are listed below:

- Soil sampling around the perimeter of Bunker 303 to identify if pesticides are exiting the bunker at any points other than the drains on the northwestern side;
- Soil sampling along any identified drainage pathway leading from the site;
- Wipe sampling inside the bunker to determine if the bunker contains residual pesticide concentrations that may act as a source; and
- Installing a monitoring well at the site to determine if the DDT and its degradation products or metals such as boron (from Ureabor) or cadmium may have migrated into groundwater.

The profile of contaminants at Bunker 303 is consistent with its recorded history. The pesticide detections of bunkers investigated as part of Sites P16 and P54 do not correspond to those at Bunker 303, with the exception of sampling at Bunker 309 where DDT and its degradation were detected above screening levels by OHM but not by E & E in recent sampling. Arsenic has not been detected above screening levels at Site P41. Thus, the further investigation of Site P41 should be considered unrelated to investigations of Site P16 and Site P54, with the possible exception of Bunker 309.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-23
Chemical Summary Report For Surficial Soils
Site: P41
Units: UGG

	Site ID	E3-P41-S01	E3-P41-S02	E3-P41-S02	E3-P41-S03	E3-P41-S03	E3-P41-S04
	Field Sample ID	SXP41011	SXP41021	SXP41022	SXP41031	SXP41032	SXP41041
	Sample Date	09/14/93	09/14/93	12/01/93	09/14/93	12/01/93	09/14/93
Test	Parameter .						
TAL METAL	Aluminum	6910	6800		7640		7150
	Arsenic	0.739	11.3 !		14.0 !		7.98
	Barium	21.7	21.7		24.1		14.4
	Beryllium	0.268 JL	0.320 JL		0.337 JL		0.310 JL
	Cadmium	1.98 K!	0.762 B!		1.19 B!		0.386 BJ
	Calcium	3760 !	699		723		691
	Chromium	25.7 !	15.1 !		20.0 !		12.2
	Cobalt	6.83 !	8.36 !		7.93 !		5.63
	Copper	190 L!	10.9 L!		11.0 L!		22.7 L!
	Iron	12000	13000 !		17000 !		10500
	Lead	100	16.0		2.90		74.0
	Magnesium	248400 !	272400 !		348400 !		163400 !
	Manganese	202 !	232 !		179 !		148 !
	Mercury	0.226	< 0.100		0.089 J		0.117
	Nickel	14.4 !	15.2 !		16.9 !		10.3
	Potassium	1270 !	1050 !		1490 !		478 K
	Sodium	104400	68.8 BJ		75.3 BJ		48.7 BJ
	Vanadium	13.0	16.9		22.9		15.0
	Zinc	70.0 J!	32.3 J		35.4 J		42.5 J
TCL Pest	Endrin	0.010 CK!	0.014 U!		0.003 BU		0.140 C!
	Heptachlor Epoxide	0.003 C!	0.001 JU		< 0.002		0.025 C!
	P,P-DDD	0.220 U!	1.00 C!		0.093 U!		3.30 C!@
	P,P-DDE	0.260 C!	0.790 C!		0.092 C		2.80 C!@
	P,P-DDT	0.370 C!	1.30 C!		0.150 C		12.0 C!@
	alpha-BHC	< 0.002	0.001 JC		< 0.002		< 0.002
	alpha-Chlordane	0.008 U	0.006 U		0.000 JU		0.200 C
	gamma-Chlordane	0.010 U!	0.001 JU		0.001 JU		0.160 C!

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-23
Chemical Summary Report For Surficial Soils
Site: P41
Units: UGG

	Site ID	E3-P41-S01	E3-P41-S02	E3-P41-S02	E3-P41-S03	E3-P41-S03	E3-P41-S04
	Field Sample ID	SXP41011	SXP41021	SXP41022	SXP41031	SXP41032	SXP41041
	Sample Date	09/14/93	09/14/93	12/01/93	09/14/93	12/01/93	09/14/93
Test	Parameter .						
TOC	Total Organic Carbon	14800					

Source: USAEC IRDMIS Level 3/E & E, 1994

Table: 1-23
Chemical Summary Report For Surficial Soils
Site: P41
Units: UGG

	Site ID	E3-P41-S04	E3-P41-S05	E3-P41-S05	E3-P41-S06	E3-P41-S06	
	Field Sample ID	SXP41042	SXP41051	SXP41052	SXP41061	SXP41062	
	Sample Date	12/01/93	09/14/93	12/01/93	09/14/93	12/01/93	
Test	Parameter .						
TAL METAL	Aluminum		9090		6720		
	Arsenic		10.4 !		16.0 !		
	Barium		40.1 !		23.8		
	Beryllium		0.373 JL		0.291 JL		
	Cadmium		1.31 B!		0.958 B!		
	Calcium		3500 !		672		
	Chromium		19.8 !		16.9 !		
	Cobalt		9.58 !		8.53 !		
	Copper		12.2 L!		11.8 L!		
	Iron		16000 !		15000 !		
	Lead		62.0		25.0		
	Magnesium		406400 !		285400 !		
	Manganese		255 !		187 !		
	Mercury		< 0.100		< 0.100		
	Nickel		18.6 !		15.3 !		
	Potassium		1640 !		1380 !		
	Sodium		82.8 BJ		47.5 BJ		
	Vanadium		25.5		22.7		
	Zinc		78.1 J!		37.9 J		
TCL Pest	Endrin		0.320 U!		0.008 KC		
	Heptachlor Epoxide		0.001 JC		< 0.002		
	P,P-DDD		30.0 C!@		0.680 U!		
	P,P-DDE		3.40 C!@		0.280 C!		
	P,P-DDT		59.0 C!@		0.890 C!		
	alpha-BHC		< 0.002		0.001 JC		
	alpha-Chlordane		0.130 U		0.003 U		
	gamma-Chlordane		0.004 U		0.003 U		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

= Exceeds ecological screening value

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

Table: 1-23
Chemical Summary Report For Surficial Soils
Site: P41
Units: UGG

	Site ID	E3-P41-S04	E3-P41-S05	E3-P41-S05	E3-P41-S06	E3-P41-S06	
	Field Sample ID	SXP41042	SXP41051	SXP41052	SXP41061	SXP41062	
	Sample Date	12/01/93	09/14/93	12/01/93	09/14/93	12/01/93	
Test	Parameter .						
TOC	Total Organic Carbon						

Source: USAEC IRDMIS Level 3/E & E, 1994

1.2.5 Site P43A/B — Disturbed Area/Stained Soils and Stressed Vegetation

These areas were initially identified as zones of stressed vegetation during a study of aerial photographs undertaken by the EPA in 1982. Area features have been illustrated in the area presented as Figure 1-6. The sites are outside the current Annex property boundary.

1.2.5.1 Site Location

Both sites are located near the Maynard Town Well No. 3 and Test Well 14 (TW-14), which was installed in 1980 to test the aquifer supporting Maynard Town Well No. 3. The sites are outside the current Annex property boundary in an area that was part of the Annex from the early 1940's to 1977. The Maynard Town Well No. 3 is a back-up well to the town's other two wells and the White Pond water supply.

Site P43A is approximately 800 feet north of the Maynard Town Well No. 3 and consists of a clearing surrounded by forest. The site was originally identified as an area of stressed vegetation and the vegetation currently found in the clearing consists of various kinds of dry grasses. The boundaries between the different kinds of grasses are visible and in some parts of the clearing grass boundaries look like stains on the ground. Physical evidence of stains was not observed at the site and no metal debris or other signs of activity were observed on and around Site P43A.

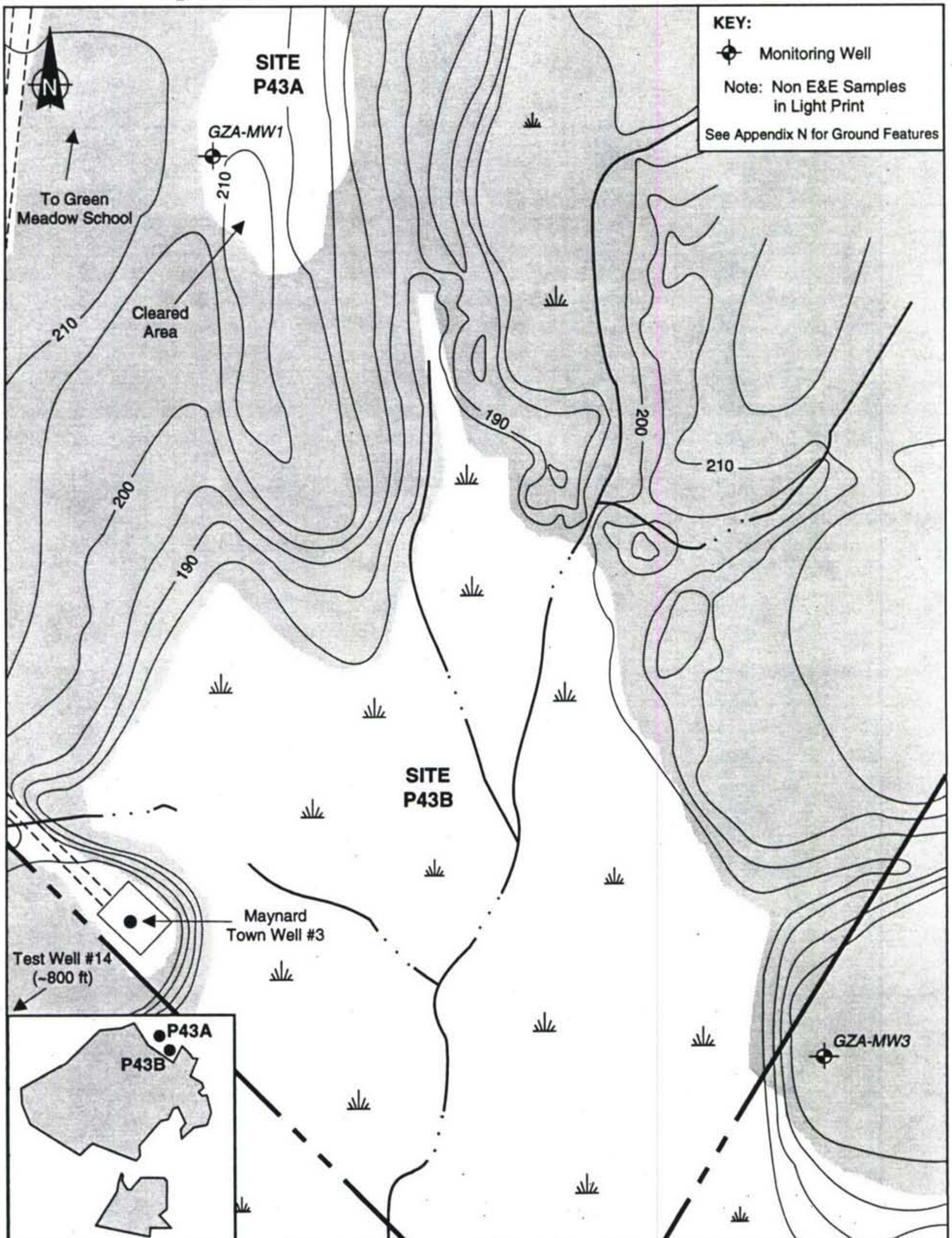
Site P43B was identified as an area of stressed vegetation between Maynard Town Well No. 3 and the parking lot south of DEC. This area coincides with an extensive wetland. The only stressed vegetation observed was a patch of dead trees drowned by the beaver dam on Taylor Brook. Given that no anthropogenically stressed vegetation could be located on the ground, Site P43B was not delineated or described.

1.2.5.2 Physical Characteristics

Site P43A is located on a ground moraine or hill of glacial till sloping south to an extensive wetland. Site P43B is contained within the wetland area. The surface elevation of P43A is approximately 212 feet AMSL while P43B lies at approximately 185 feet AMSL. Groundwater elevation is approximately 197 feet AMSL at P43A.

Monitoring well GZA-MW1 was installed by Goldberg-Zoino and Associates (GZA), Inc., in 1990, to a total depth of 24.7 feet. Drilling logs indicate that the glacial till, consisting of a tight, poorly sorted sand and gravel mixture, extends to a depth of 9.2 feet. Bedrock was encountered at 9.2 feet BGS and a rock core was recovered from 9.7 to 24.7 feet BGS. The bedrock was identified as Gospel Hill Gneiss by GZA. Outcrops of similar bedrock material are visible less than 500 feet east and southeast of P43A (refer to Figures 2-1 and 2-2, Volume I). No subsurface exploration was undertaken and no geotechnical samples were collected at P43B so soil characteristics and depth to bedrock at this location are unknown.

11: SUDBURY\NFADD\UC6_P43.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-6 MAP OF SITE P43A AND B DISTURBED AREAS/VEGETATION STRESS

Surface water flows south and southeast from Site P43A to the wetland containing Site P43B. Wetland drainage is provided by Taylor Brook. During well installation at GZA-MW1, slightly fractured bedrock was encountered at 9.7 feet BGS. Water level measurements collected in September and December 1993 at this location (refer to Table 1-2) showed groundwater at depths of 16 and 14 feet BGS, indicating that the groundwater flows in bedrock. The probable groundwater flow direction is south from Site P43A into the adjacent wetland. No groundwater was observed in the overburden at Site P43A.

1.2.5.3 Ecological Characterization

The open area associated with Site P43A is vegetated with various types of grasses and forbs. Surrounding the open grass area is a mixed oak forest with trees ranging from one foot to 20 feet in height (LFS 1983).

Site P43B was indicated on aerial photographs as being on the southeast edge of the wetland south of P43A between the Maynard Town Well No. 3 and a large parking lot around DEC buildings. It has been tentatively identified as an area of stressed vegetation and is an open area with small patches of grasses and forbs scattered throughout. The extensive wetland around it is vegetated by deciduous shrubs and several types of grasses (USDOI 1977).

The two main habitat types near Site P43A and Site P43B are open area and forested wetland. The open grass areas at each site are likely to be used by various species of songbirds, gamebirds, small mammals and ground-nesting birds. The oak forest surrounding P43A also provides nesting and roosting areas for songbirds and gamebirds, and provides a food source of acorns, buds, twigs, and foliage to many wildlife species (Martin *et al.* 1951). The forested wetland associated with Site P43B attracts many upland species and also provides a moist environment adequate for various species of reptiles and amphibians and other semi-aquatic and aquatic species.

No unique upland or wetland habitats have been identified for Sites P43A and P43B (NHESP 1992). Additionally, no rare, threatened, or endangered species are known to occur near the two areas.

1.2.5.4 Site History

It is possible that these sites were identified by aerial photographs (EPA 1982) because of variations in the color of surrounding vegetation. Maps of the facility from 1944 through 1974 do not note any structures, roads, or other evidence of activity in these areas. An aerial photograph from 1940 indicates dense vegetation in the areas, while in 1952, an aerial photograph indicates less dense vegetation. Reconnaissance of the areas in 1991 by OHM noted some burned trees and a wooden shelter at Site 43A.

1.2.5.5 Results of Previous Investigations

Work performed at Sites P43A and P43B is described in Section 7.52 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994).

In 1985, Dames and Moore conducted a field reconnaissance of both sites and failed to note any evidence of dumping. In 1991, GZA noted "poor vegetative cover" (grasses only) at Site P43A. GZA installed a monitoring well (GZA-MW1), collected a soil sample from 0 to 2 feet BGS at the monitoring well, and a surface soil sample from the vicinity of Site P43A (OHM 1993a). Groundwater quality as tested by GZA in 1991 showed iron (0.61 mg/L) and manganese (0.064 mg/L) in excess of secondary drinking water standards in a groundwater sample from well GZA-MW1. These findings were not attributed to any area related contamination but to naturally occurring levels.

Resampling by OHM in 1992 found elevated manganese in one (OHM-BW-2) of four samples. The chlorinated herbicide DCPA (Dacthal) and acetone, carbon disulfide, and methyl isobutyl ketone, were found in groundwater from Maynard Town Well No. 3 in the June 1992 sampling round. None of these compounds were detected in the October 1992 sampling round. Methyl-n-butyl ketone and methylene chloride were found in groundwater from TW-14 in the June 1992 sampling round but these and other VOCs were absent in the October 1992 round. A phthalate, bis(2-ethylhexyl)phthalate was detected in June 1992 (90 μg/L), and at in the October 1992 (14 μg/L) sampling of TW-14. Bis(2-ethylhexyl)phthalate (9.8 μg/L) was also found in groundwater from well GZA-MW3 in the October 1992 round. The likely source of these contaminants is laboratory handling or field sampling practices. An MCL of 6 μg/L was established for this compound in July 1992.

Elevated levels of petroleum hydrocarbons (200 μg/g) were detected by GZA in 1991 in a subsurface soil sample taken from GZA-MW1, and at a concentration of 70 μg/g in the sample duplicate. GZA postulated that the TPHC might have been the result of natural decay of organic matter in the area. A trace of benzoic acid in the soil sample from GZA-MW1 was the only BNA detected. Soil samples showed no evidence of disposal. An enhanced area reconnaissance by OHM took place in 1992 and found no evidence of area dumping or stressed vegetation.

1.2.5.6 Field Work Performed

After field consultations during July 1993, an agreement was made to modify the original work plan. GZA-MW1 lies downgradient of the clearing identified as Site P43A and was originally installed to monitor groundwater from the site. This well was deemed sufficient to determine groundwater conditions downgradient of Site P43A. Consequently, no additional well was installed. In addition, the location of the clearing identified in past aerial photographs as Site P43B was not established with any certainty. As a result, a well was not installed at Site P43B as originally planned. The existence of a second well (TW-14), located between the Maynard Well and Annex property, reinforced the justification for work plan modification. The scope of work was expanded to include sampling at TW-14 to investigate

the presence of any contaminant plume migrating from former facility sites towards the Maynard Town Well.

This sampling plan was arrived at based on thorough examination of the area and the lack of physical evidence supporting environmental degradation or contamination. The two existing wells (GZA-MW1 and TW-14) were then sampled to sufficiently characterize area groundwater quality and to investigate the presence of any contaminant plumes which threatened the drinking water source. In addition, the Maynard Town Well itself was sampled to further characterize groundwater quality in the area.

Analytical Parameters

All samples collected during the field investigation were analyzed for TCL organics, TAL metals, and herbicides. A summary of Phase II Sampling Activities at Site P43A/B is provided as Table 1–24.

Table 1-24

PHASE II SAMPLING EFFORTS AT SITE P43A/B — DISTURBED AREA/STAINED SOILS AND STRESSED VEGETATION

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	3	09/02/93 09/03/93	Samples were collected from GZA-MW1, TW-14 and Maynard Town Well No. 3 to characterize groundwater quality and investigate the potential for any existing contaminant plumes to migrate towards the Town of Maynard's backup drinking water well.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

A summary of the detections above preliminary screening levels is provided in Table 1-25. Three existing wells were sampled in September 1993 to investigate groundwater quality and the potential for contaminant migration through the groundwater pathway. The purpose of the groundwater sampling was to determine whether contaminants were migrating toward the Maynard Town Well No. 3, a backup drinking water well. Two of the three wells sampled lie in strategic locations relative to the Maynard Town Well No. 3. One well, TW–14, is located southwest of the Maynard Town Well No. 3, towards Annex property. This location provided data to evaluate the potential for contamination to migrate from Annex property towards the drinking water source. The second well, GZA–MW1, was sampled to investigate groundwater quality and assess the potential for any contamination to migrate from the cleared area (Site P43A) towards Maynard Town Well No. 3. Maynard Town Well No. 3 was sampled by turning on a fire hydrant connected to the well and allowing water to run for approximately 10 minutes before collecting groundwater samples. The samples were used to assess the groundwater quality of the potable water source.

Table 1-25

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P43A/B

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Maximum Concentration	Well ID	Frequency Above Screen Level
GW (μg/L)	Aluminum (U)[1]	--	50	MA SMCL[2]	228	TW-14	1/3
	Iron (U)	--	300	MA SMCL	26,000(K)[4]	TW-14	1/3
	Lead (U)	--	15	MA MCL[3]	28.8	TW-14	1/3
	Manganese (U)	--	50	MA SMCL	518	TW-14	1/3

[1]U = Unfiltered groundwater sample.
[2]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[3]MA MCL = Massachusetts Maximum Contaminant Level.
[4] K = Results are affected by interferences or high background

Source: Ecology and Environment, Inc. 1994.

1.2.5.7 Nature and Extent of Contamination

A summary of the analytical results for Site P43 is provided in Table 1-26 following Section 1.2.5.8, Conclusions and Recommendations. Groundwater sampling at the wells related to Site P43A/B was conducted to assess any potential impact on groundwater from the two sites, and also to determine if contaminants are migrating from the Annex property northward toward the Maynard Town Well No. 3. Analysis of the sample from GZA-MW1, which is downgradient of Site P43A, did not detect any inorganic analytes in excess of groundwater screening levels. Many metals were not detected. Iron (79.9 μg/L) and manganese (22.4 μg/L) were found at concentrations below secondary drinking water standards; whereas, they had been detected above the secondary levels by GZA in 1991. No organic compounds were detected in the sample from the GZA-MW1 well. No contaminants were reported in earlier groundwater sampling by OHM at the GZA-MW1 well.

TW-14 was originally sampled to investigate whether any contaminants from the Annex were migrating northward from the Annex property in the direction of the Maynard Town Well No. 3. Aluminum, iron, lead, and manganese were detected in the unfiltered sample from this well at concentrations above groundwater screening levels. Aluminum (228 μg/L), iron (26,000 μg/L), and manganese (518 μg/L) were elevated above the MA SMCL for these compounds. Lead (28.8 μg/L) was elevated above the MA MCL of 15 μg/L. Given that this sample was unfiltered, it is probable that these metal concentrations are the result of suspended solids in the groundwater sample. Metal concentrations in filtered groundwater samples taken by OHM in 1992 at this well were not elevated. No organic compounds were detected in this well from E & E sampling. OHM sampling of TW-14 detected bis(2-ethylhexyl)phthalate (90 μg/L) in June 1992, and at 14 μg/L in October 1992. However, this compound is a common field sampling and laboratory artifact. An MCL of 6 μg/L was established for this compound in July 1992. Several other VOCs were also found by OHM at TW-14 including methylene chloride, methyl-n-butyl ketone and di-n-butyl

phthalate but these compounds were only detected in one out of two OHM sampling rounds. None of these compounds were found when E & E sampled well TW-14.

The Maynard Town Well No. 3, which is a backup well to Maynard's other two drinking water wells and the White Pond water supply, was sampled to profile groundwater in the area and also to identify any potential contamination migrating into this well. Many of the metals in the groundwater sample from this well were not detected at levels above the method detection limit. None of the metals exceeded groundwater screening levels (which include both primary and secondary standards).

The metals detected above screening values in the sample from TW-14 (aluminum, iron, lead, and manganese) were all detected at lower concentrations in Maynard Town Well No. 3. This is probably due to the fact that Maynard Town Well No. 3 is a production well that is designed to produce a large capacity of water. Well TW-14 is a smaller diameter well, and pumped infrequently which could result in the accumulation of rust, silt, and clay in the well. No organic compounds were detected in analysis of the E & E groundwater sample from this well. In previous sampling by OHM in 1992, a chlorinated herbicide, Dacthal (0.692 μg/L), acetone (12 μg/L), carbon disulfide (2 μg/L), and methyl isobutyl ketone (7.9 μg/L) were found in the June 1992 sampling round but not in the October 1992 round. The concentrations of these compounds detected in the June 1992 OHM sampling round were all below groundwater screening levels used in this SI.

1.2.5.8 Conclusions and Recommendations

Groundwater sampling does not indicate any impact from Site P43A on groundwater as evidenced by sampling results from GZA–MW1. Sampling of well TW-14 did indicate the presence of aluminum, iron, lead, and manganese in unfiltered samples at concentrations above groundwater screening levels, but these results probably reflect naturally occurring levels in the surrounding aquifer that are present as suspended solids in the groundwater. Metals were not elevated in filtered samples taken by OHM at well TW-14. No contaminants were detected in the Maynard Town Well No. 3.

Given the results of sampling at GZA–MW1 and at Maynard Town Well No. 3, there is no discernable impact from Sites P43A and P43B on groundwater in the area. No evidence of contamination and no identification of any potential sources at these sites has been made. Thus, no further action is recommended at these sites.

No further action is recommended regarding well TW-14. While several metals were elevated in an unfiltered sample from this well taken by E & E, previous results from OHM filtered sampling at this well did not detect elevated metals in the groundwater, indicating that dissolved metals are not present at levels of concern. The detection of bis(2–ethylhexyl phthalate) by OHM in two 1992 groundwater sampling rounds at concentrations above the MCL value was not confirmed by E & E groundwater sampling at well TW-14, and was probably the result of sample handling either in the field or the laboratory.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 1-26
Chemical Summary Report For Groundwater
Site: P43
Units: UGL

	Site ID	GZA-MW1	MAYNARD03	TW14			
	Field Sample ID	MXP43GZ1	MXP43031	MXP43141			
	Sample Date	09/03/93	09/03/93	09/02/93			
Test	Parameter .						
TAL METAL	Aluminum	23.2 BJ	< 25.0	228 @			
	Arsenic	< 2.00	< 2.00	1.02 J			
	Barium	< 10.0	5.30 J	5.48 J			
	Cadmium	< 5.00	< 5.00	1.58 J			
	Calcium	2120	2470	2300			
	Chromium	< 10.0	< 10.0 K	12.8			
	Cobalt	< 10.0	< 10.0	7.78 J			
	Copper	< 10.0	< 10.0	37.3			
	Iron	79.9 B	148 K	26000 K@			
	Lead	< 5.00	< 5.00	28.8 @			
	Magnesium	511	612	610			
	Manganese	22.4	16.6	518 @			
	Nickel	< 10.0	< 10.0	28.4			
	Potassium	551 J	1880	364 J			
	Sodium	2690	3640	2690			
	Vanadium	< 10.0	< 10.0	4.43 J			
	Zinc	21.1 B	3.18 BJ	569			
TCL BNA	MOLEAT	6.50					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

= Exceeds ecological screening value

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.

C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

1.2.6 Site P52 — Possible Dump Near Federal Emergency Management Agency (FEMA) Property

Site P52, a former gravel pit and a possible dump, was identified during an EPA review of aerial photographs taken in 1982. Figure 1-7 provides an area map.

1.2.6.1 Site Location

Site P52 lies about 1,000 feet northwest of the east gate of the Annex and is accessed from Patrol Road. An earthen mound partially blocks the entrance to this former gravel pit. On the north side of the fence line there is a road lined by mature trees arranged in two parallel lines, as if they had been planted at the site. Approximately 20 feet northeast on the old road and on its western side, there is a large depression and two concrete slabs overgrown with vegetation which may have been a foundation. Further north on the old road is a large pile of rocks and debris including gas cans and metal scrap. Approximately 20 feet beyond the rock pile, there is a debris-littered clearing in the forest.

1.2.6.2 Physical Characteristics

Site P52 is a former gravel pit (OHM 1992) in an area of glacial outwash immediately adjacent to a ground moraine (hill of glacial till) and a bedrock outcrop of the Marlboro Formation (amphibolitic schist) at the east side of the site. Surface elevations at the site range from 215 to 195 feet AMSL, and slope gently to the northwest. No subsurface soil exploration occurred at this location, however, grain size and Atterberg limits analyses performed on surface soil sample E3-P52-S01 identified the surface soil in this area as moderately plastic (liquid limit 35 to 50), silty sand with gravel. Appendix D contains a complete summary of geotechnical results. Depth to bedrock is unknown but, as indicated by adjacent outcrops, is probably very shallow.

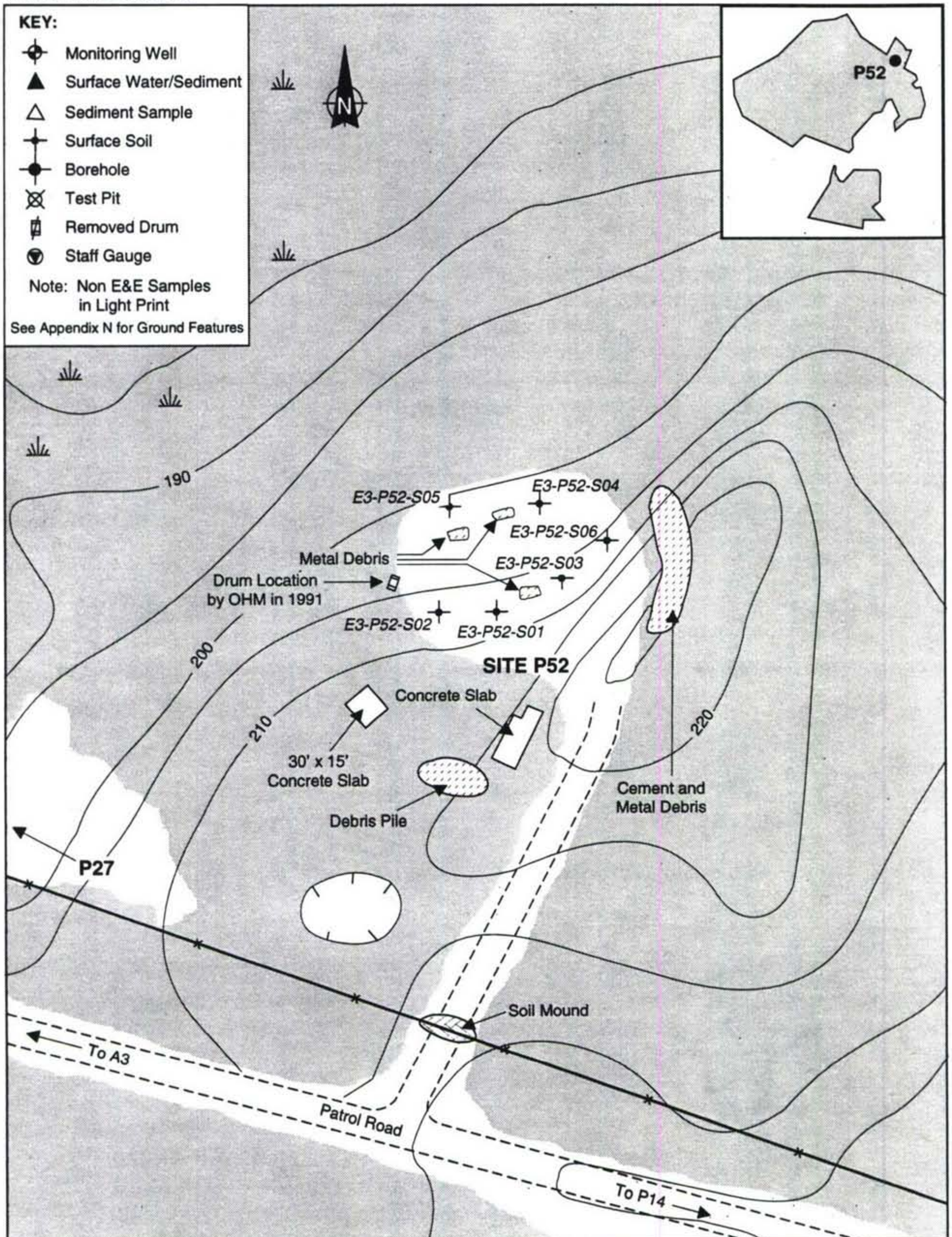
Surface water flow from the site is northwest toward a wetland that drains to Taylor Brook. No wells were installed at P52, but based on topography and drainage, groundwater is probably less than 20 feet BGS and flow is northwest toward the adjoining wetland.

1.2.6.3 Ecological Characterization

Site P52 lies in a dense, mixed white pine and oak forest with trees ranging in height from 40 to 60 feet (LFS 1983). Based on the topography of the area, it appears that most of the surface water runoff from Site P52 would flow in a north-northwest direction. Therefore, a wetland located approximately 500 feet north of the site and vegetated with deciduous trees and shrub, is a potential receptor of surface water runoff.

This area provides two distinct habitats: upland forest and forested wetland. Pine and oak trees are very valuable to wildlife since upland game birds, songbirds, and small mammals rely on pine seeds, oak acorns, twigs, bugs, and flowers for much of their diet (Martin *et al.* 1951). In addition, pine trees as well as oaks provide shelter to deer and

11: SUDBURY\UC6_P52.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-7 MAP OF SITE P52
POSSIBLE DUMP NEAR FEMA PROPERTY

rabbits in the winter. Many species of reptiles and amphibians also live beneath the thick mat of fallen oak leaves. The scrub/shrub-forested wetland west of the site is expected to attract a variety of species due to the abundance of water, food sources, and vegetation cover in the area. Consequently, both upland species and species specifically adapted to wetlands will frequent this area.

No rare, threatened, or endangered species are known to occur near Site P52 and no unique habitats have been identified in the area (NHESP 1992).

1.2.6.4 Site History

Site P52 was identified by aerial photographs as a possible dump (EPA 1982). Facility maps from 1944, 1955, and 1962 show no sign of roads, structures or activity in the area. However, a 1952 aerial photograph shows the area as cleared. Facility maps from 1967 and 1974 indicate a road stemming from Patrol Road that may lead toward the area. No other historical data could be located regarding Site P52.

1.2.6.5 Results of Previous Investigations

In 1985, Dames and Moore, the USAEC, Fort Devens, and the Massachusetts Department of Environmental Quality and Engineering (MADEQE) performed an enhanced site reconnaissance of P52. An old gravel pit, concrete blocks, plate steel, and automobile fuel tanks were noted at the site (OHM 1994).

In 1991, OHM conducted an enhanced area reconnaissance and two "concrete slabs" were identified at the end of the path leading from Patrol Road. A concrete structure with pipes was also noted and scrap metal was found in several locations. One empty drum was found along the edge of the clearing located in the northern corner of the area (OHM 1994).

1.2.6.6 Field Work Performed

Analytical Parameters

All samples collected during the E & E field investigation were analyzed for TCL organics, TAL metals, explosives, and TOCs. In addition, one of the surface soil samples collected was sent for geotechnical analysis to determine grain size distribution. A summary of Phase II Sampling Activities at Site P52 is provided as Table 1-27.

Surface Soil Sampling

A total of six surface soil samples were collected for chemical analysis from a possible dump area located roughly 1,000 feet from FEMA property situated near the northeast corner of the facility, just outside the east gate of the Annex. The samples were collected to investigate the nature of surface contamination near the dump area and to

Table 1-27

PHASE II SAMPLING EFFORTS AT SITE P52 — POSSIBLE DUMP NEAR FEMA PROPERTY

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	6	08/30/93	Samples were collected to investigate the nature of surface contamination and assess the dump area as a potential contaminant source.
	1	08/30/93	A geotechnical sample was collected at location E3-P52-S01 to characterize the nature of surface soils.

Source: Ecology and Environment, Inc. 1994.

characterize Site P52 as a potential source of contaminant migration. Soil samples were collected from areas just below metal debris or concrete slabs, or from areas downgradient in obvious surface drainage channels. One of the samples, E3-P52-S01, was analyzed for grain size distribution.

1.2.6.7 Nature and Extent of Contamination

A summary of the detections above preliminary screening levels is provided in Table 1-28. A chemical summary of analytical results is provided in Table 1-29. Analysis of surface soil samples taken at Site P52 indicated the presence of several metals including arsenic, barium, chromium, cobalt, copper, manganese, nickel, and zinc at concentrations above background levels. Given that these samples were taken just below metal debris or in obvious surface drainage channels, the likely source of the elevated concentrations of metals is the debris itself. Beryllium (0.512 μg/g) was found slightly above the soil screening level of 0.4 μg/g (MCP GW-1/S-1). However, the highest concentration in soils at the site was also only slightly above the background level of 0.446 μg/g and is likely to be a naturally occurring level. Arsenic (36.0 μg/g) was found in one sample at E3-P52-S02, which is slightly above the soil screening level of 30 μg/g (MCP GW-1/S-1 and GW-3/S-3). This sample was taken at a point near where a map prepared by OHM had located a drum (OHM 1994).

Several PAHs were detected including benzo(*b*)fluoranthene, fluoranthene, phenanthrene, and pyrene. All PAHs were found in low concentrations below screening levels and may be related to fuel or petroleum residue from the scattered debris at the site. Two pesticides α-endosulfan, and DDE were found in soils, but at concentrations below soil screening levels.

Table 1-28

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P52

Medium (Units)	Compound	Maximum Background	Screen Level	Source	Max. Concen-tration	Sample Location ID	Frequency Above Screen Level
SOIL (μg/g)	Arsenic	17	10	MCP GW-1/S-1[1]	36.0	E3-P52-S02	1/6
	Beryllium	0.446	0.4	MCP GW-1/S-1	0.512 (est.)	E3-P52-S05	4/6

*MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

1.2.6.8 Conclusions and Recommendations

OHM initially reported that reconnaissance of Site P52 had identified minor dumping items such as concrete blocks, plate steel, metal car parts, and automobile fuel tanks. In addition, a drum was identified in an OHM map of the site. Neither the drum nor the fuel tanks were located during subsequent field sampling efforts by E & E.

A site walkover was conducted on 22 June 1994, at which time EPA, MDEP, and Fort Devens project managers agreed that since the site poses little risk, having only one of six arsenic detections above the screening level, no further action is needed.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-29
Chemical Summary Report For Surficial Soils
Site: P52
Units: UGG

Test	Site ID	E3-P52-S01	E3-P52-S01	E3-P52-S02	E3-P52-S03	E3-P52-S04	E3-P52-S05
	Field Sample ID	SDP52011	SXP52011	SXP52021	SXP52031	SXP52041	SXP52051
	Sample Date	08/30/93	08/30/93	08/30/93	08/30/93	08/30/93	08/30/93
Test	Parameter						
EXPLOSIVES	4-Amino-2,6-dinitrotoluene	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
TAL METAL	Aluminum	7950	8540	10400	9560	7750	10800 !
	Arsenic	14.0 !	14.0 !	36.0 !@	9.82	6.92	10.0
	Barium	24.6	28.0 !	23.3	27.8 !	25.7 !	22.1
	Beryllium	0.390 J	0.446 J@	0.476 J!@	0.444 J@	0.360 J	0.512 J!@
	Calcium	382 J	557	< 500	391 J	307 J	< 500
	Chromium	11.0	11.7	12.8	16.8 !	15.5 !	14.7 !
	Cobalt	4.71	4.59	4.10	6.72 !	5.44	5.08
	Copper	9.40	10.4	8.98	11.0 !	10.6	8.63
	Iron	12000	12000	9800	11300	10000	10100
	Lead	70.0	75.0	110	41.0	20.0	41.0
	Magnesium	957	933	850	2130	2290	1300
	Manganese	97.9 !	118 !	112 !	106 !	81.1	84.8
	Nickel	11.8 !	11.5 !	10.4	14.6 !	11.8 !	10.4
	Potassium	327 K	310 K	265 B	998 !	1330 !	485 K
	Selenium	0.420	0.327	0.421	0.220 J	0.240	0.303
	Vanadium	16.2	17.4	17.1	22.0	21.0	21.8
	Zinc	160 !	180 !	51.7 !	26.8	22.3	20.4
TCL BNA	2-Fluorophenol		0.560				
	Benzo(b)fluoranthene	0.052 J	< 0.330	0.079 J	< 0.330	< 0.330	< 0.330
	Bis(2-ethylhexyl)phthalate	< 0.330	< 0.330	< 0.330	0.023 J	< 0.330	< 0.330
	C15						0.120
	Fluoranthene	< 0.330	< 0.330	0.091 J	< 0.330	< 0.330	< 0.330
	Phenanthrene	< 0.330	< 0.330	0.056 J	< 0.330	< 0.330	< 0.330
	Pyrene	0.056 J	< 0.330	0.090 J	0.028 J	0.024 J	< 0.330
TCL Pest	Endosulfan,A	< 0.002	< 0.002	< 0.002	< 0.002	0.000 JC	0.000 JC
	P,P-DDE	0.033 C	0.037 C	0.012 C	0.013 C	0.007 C	0.023 C

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

= Exceeds ecological screening value

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-29
Chemical Summary Report For Surficial Soils
Site: P52
Units: UGG

	Site ID	E3-P52-S01	E3-P52-S01	E3-P52-S02	E3-P52-S03	E3-P52-S04	E3-P52-S05
	Field Sample ID	SDP52011	SXP52011	SXP52021	SXP52031	SXP52041	SXP52051
	Sample Date	08/30/93	08/30/93	08/30/93	08/30/93	08/30/93	08/30/93
Test	Parameter .						
TCL Pest	P,P-DDT	0.056 C	0.065 C	0.015 C	0.028 C	0.013 C	0.045 C
TOC	Total Organic Carbon	71300	76600	74100	37900	31300	53100

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-29
Chemical Summary Report For Surficial Soils
Site: P52
Units: UGG

	Site ID	E3-P52-S06					
	Field Sample ID	SXP52061					
	Sample Date	08/30/93					
Test	Parameter .						
EXPLOSIVES	4-Amino-2,6-dinitrotoluene	< 1.00					
TAL METAL	Aluminum	8000					
	Arsenic	7.96					
	Barium	28.2 !					
	Beryllium	0.367 J					
	Calcium	390 J					
	Chromium	16.1 !					
	Cobalt	6.65 !					
	Copper	11.8 !					
	Iron	10000					
	Lead	27.0					
	Magnesium	2590 !					
	Manganese	99.6 !					
	Nickel	12.6 !					
	Potassium	1450 !					
	Selenium	< 0.200					
	Vanadium	20.4					
	Zinc	26.1					
TCL BNA	2-Fluorophenol						
	Benzo(b)fluoranthene	< 0.330					
	Bis(2-ethylhexyl)phthalate	< 0.330					
	C15						
	Fluoranthene	< 0.330					
	Phenanthrene	< 0.330					
	Pyrene	< 0.330					
TCL Pest	Endosulfan,A	0.000 JC					
	P,P-DDE	0.010 C					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-29
Chemical Summary Report For Surficial Soils
Site: P52
Units: UGG

	Site ID	E3-P52-S06					
	Field Sample ID	SXP52061					
	Sample Date	08/30/93					
Test	Parameter .						
TCL Pest	P,P-DDT	0.014 C					
TOC	Total Organic Carbon	22900					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

1.2.7 Site P54 — Additional Bunkers 305, 307, and 314 and Additional Bunkers 301, 304, 311, 312, and 318

Site P54 was identified during a 1990 interview with a Natick Laboratory employee, who indicated that chemical stocks and wastes were stored in Bunker 305 and may have been dumped around Bunkers 303, 307, and 314 (Bunker 303 has been investigated separately as Site P41). Because of the results of the OHM sampling of the original three bunkers (305, 307, and 314), which showed elevated levels of some metals and pesticide residues in soils, it was decided to sample five additional, randomly selected, bunkers to determine if similar levels are typical of all bunkers. The additional bunkers selected were 301, 304, 311, 312, and 318, all within the same general area as the original three. Figure 1-8 provides a site map. Because of the dispersed nature of Site P54, please refer to Figure 1-1 and Figure 1-8 to locate the other bunker Sites P16 and P41.

1.2.7.1 Site Location

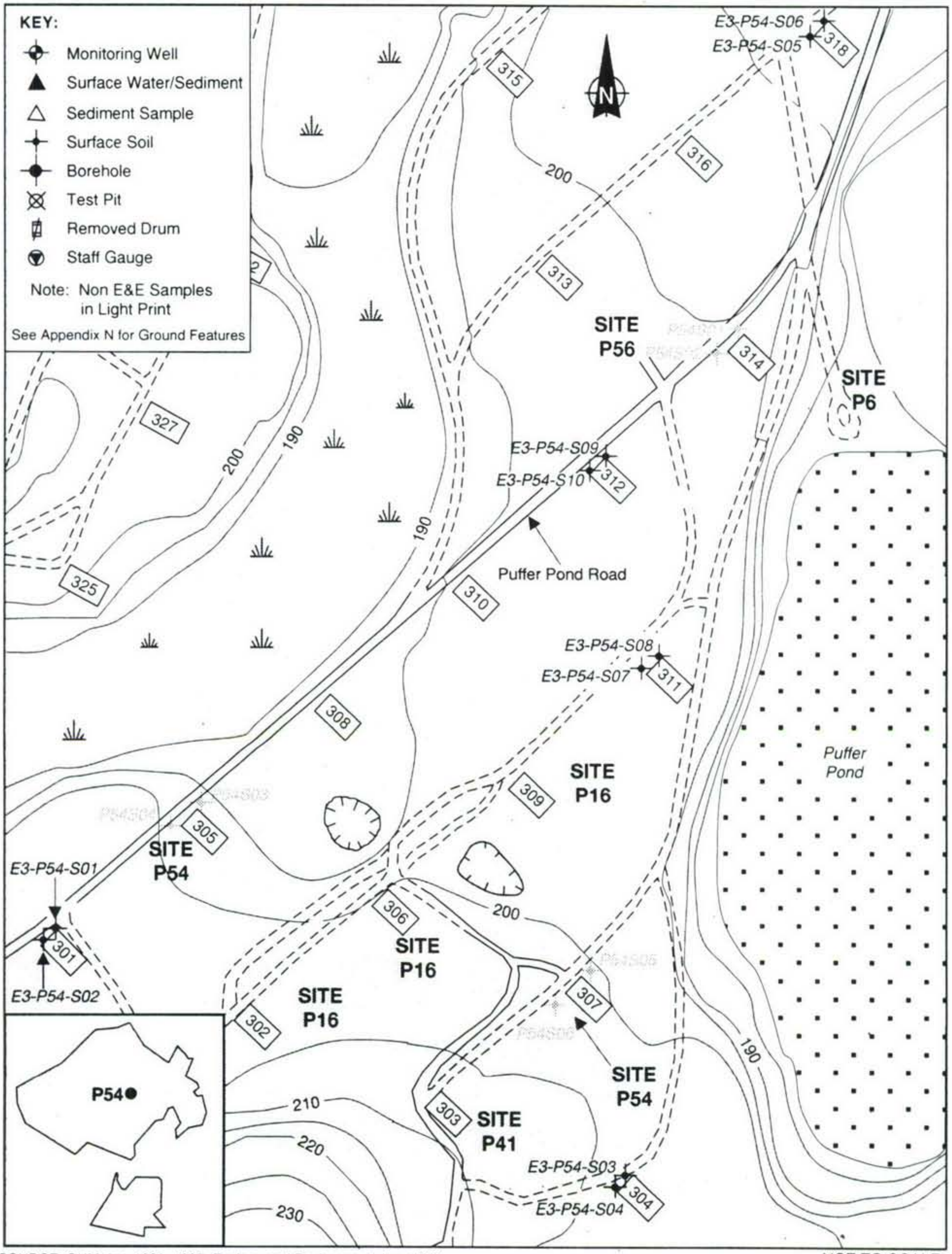
All the bunkers are located in the central part of the Annex, immediately west of Puffer Pond. The entrance to each bunker faces a dirt road that was formerly a railroad bed, and each bunker is surrounded by forest on the other three sides. The bunkers are built of concrete with a one to two foot layer of soil with grass. In the past the bunkers were maintained to reduce the risk of fire hazard; however, most of the surface area around the bunkers has since been covered by woody plants. The soil covering the bunkers is mostly covered with grasses, bushes, and emerging undergrowth.

1.2.7.2 Physical Characteristics

The Site P54 bunkers all lie in a relatively level area of glacial outwash sand and gravel between Puffer Pond to the east, a wetland to the west, a hill of till to the south, and Taylor Creek to the north. Surface elevations in the area range from 195 to 205 feet AMSL. No subsurface exploration occurred at the site; however, a grain size and Atterberg limits analyses performed on surface soil sample E3-P54-S05 identified the surface soil in the area as non-plastic, well-graded sand with silt and gravel. Appendix D contains a complete summary of geotechnical results. Depth to bedrock is unknown. The underlying bedrock is projected to be the Marlboro Formation (Hansen 1956).

Surface water drainage at Bunker 301 is north into the adjacent wetland. The remaining bunkers included in the E & E site sampling (304, 311, 312, and 318) appear to drain east to Puffer Pond and the wetland adjoining Puffer Pond to the north. No wells were installed at Site P54, but based on topography and drainage, groundwater is probably shallow in this area (less than 20 feet BGS) and flow is probably north at Bunker 301, and northeast at the remaining bunkers. Discharge flows into Puffer Pond and adjacent wetlands, all of which are drained by Taylor Brook.

11: SUDBURY\UC6_P54.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-8 MAP OF SITE P54
BUNKERS 305, 307, 314
SUPPLEMENTAL BUNKERS 301, 304, 311, 312, 318

1.2.7.3 Ecological Characterization

The sites of all the bunkers are located within a dense, white pine and oak forest with trees ranging in height from 40 to 60 feet (LFS 1983).

Due to the relatively level topography of the site, it is difficult to determine the direction of surface water runoff. Therefore, all wetland areas located near the bunkers are considered potential receptors of surface water runoff. Located west of all the bunkers, there is a seasonally saturated wetland vegetated with deciduous trees. Puffer Pond, a permanent, open-water system, is located 500 feet east of Bunkers 307, 311, and 314. Finally, a third forested wetland along Taylor Creek and vegetated with deciduous trees is located north of the bunkers (USDOI 1977). In addition, two vernal pools are associated with the wetlands near Bunkers 305 and 307. The first, Bunker Road Pool, is located northwest of the wetland near Bunker 305 and the second, Bunker Corner Pool, is located between Bunkers 305 and 307 (Butler 1992).

This area combines three habitat types: upland forest, forested wetland, and open water. White pines and oak trees provide nesting and roosting areas for many songbirds and upland gamebirds while also providing cover for various species of mammals. Songbirds, upland gamebirds, small mammals, and deer rely on pine seeds, oak acorns, buds, twigs, and flowers for much of their diet (Martin *et al.* 1951). The wetlands near Site P54 are expected to support a diverse community because the various species of trees associated with such wetland areas provide cover, nesting and roosting areas, and a source of food for many species of birds and mammals. Finally, open water areas such as the nearby vernal pools provide habitat for various aquatic and semi-aquatic wildlife species including fish, reptiles, and amphibians. Waterfowl and piscivorous birds are also known to frequent this type of habitat.

Bunker Corner Pool has been found to provide suitable habitat for the spotted salamander (*Ambystoma paterale*), a Massachusetts state-listed species of special concern, found nesting in the area (Butler 1992). No unique habitats have been identified in the general vicinity of the site (NHESP 1992).

1.2.7.4 Site History

Site P54 was identified by a Natick Laboratory employee who stated that chemical stocks and wastes were stored in Bunker 305 and may have been dumped around Bunkers 303 (Site P41), 307, and 314 (Interview 1990b).

Bunker 305 was used by a division (C & OMD) of Natick Laboratories in 1964. In 1973 the bunker was used by another division (C & PLSE) of Natick Laboratories for the storage of textiles. In 1977, the supply office of Natick Laboratories had use of the bunker, but it was vacant at the time of the 1977 inspection and was also vacant at the time of the 1982 inspection. The 1992 inspection listed bunker use by the U.S. Army Reserves. In 1992, the bunker contained boxes marked "coal heater" and "screen latrine." A single drum

was noted at the external, southwest side of the bunker with metal debris noted on the southeast side of the bunker.

Bunker 307 was used for chemical storage from 1954 to 1974 according to a Natick employee (Interview 1979c). In 1964, the bunker was used by the Natick Engineering Office. In 1971, it was used for chemical storage. In 1973, the bunker was used by the supply office at Natick for chemical stock. Reportedly, chemical storage ceased sometime in 1974. In 1977, the bunker was used by the Army Research Institute of Environmental Medicine (ARIEM) of Natick to store empty crates, laboratory equipment, and books. A 1992 inspection noted that the bunker contained boxes of files, exercise equipment, laboratory instruments, assorted medical equipment, and an empty, liquid hydrogen container.

Bunker 314 was also used in 1964 and 1971 by the Mechanical Engineering Division of Natick for the storage of volatile fuels. In 1973, the bunker was used by the Pioneering Research Laboratory of Natick also for the storage of volatile fuels. In 1977, the bunker was controlled by the supply office at Natick but was vacant at the time of the 1977 inspection. A 1992 inspection noted that the bunker was still used by Natick Laboratories, but contained only numerous boxes of Meals-Ready-to-Eat (MREs).

1.2.7.5 Results of Previous Investigations

Results of the area investigation conducted at Site P54 are included in the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). The area investigation conducted at the three bunkers in 1991 consisted of a detailed inspection of the interiors and exteriors of the bunkers and surface soil sampling.

An empty drum was found standing at the external southwest side of Bunker 305. The interior of Bunker 305 revealed a coal heater and a latrine screen and staining was observed on the east wall and floor near the middle of the bunker. The floor drain on the east side of the bunker was rusted and damp while the west side drain was dry with no signs of rust. White powder believed to be mold was noted on the floor, in the drain canals, and on the ceiling.

Bunker 307 was full of files, exercise equipment, laboratory instrumentation, and assorted medical equipment. The bunker was so packed that it was impossible to see the floor or any stains.

Bunker 314 contained several boxes of MREs. No signs of stains were noted.

Surface soil samples were taken near the drains of all three bunkers and were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, TAL metals, explosives, and chlorinated herbicides. The samples showed elevated levels of metals copper, lead, mercury, and zinc that were not above soil screening levels. Pesticides including DDT and its degradation products, DDD and DDE, as well as dieldrin, lindane, heptachlor epoxide, and α–chlordane were also detected in the soil samples. The only

exceedances of soil screening levels were for lindane (0.31 μg/g) and heptachlor epoxide (0.063 μg/g) in samples from Bunker 305.

1.2.7.6 Field Work Performed

Low levels of surface contamination were found in previous samples collected from three storage bunkers at the Annex (Bunkers 305, 307, 314). Based on these results, a plan was developed to sample five randomly selected bunkers to investigate each of the bunkers as a potential contaminant source due to past facility storage activities.

Analytical Parameters

All samples collected during the field investigation were analyzed for TCL organics, TAL metals, and TOCs. In addition, one of the surface soil samples collected was sent for geotechnical analysis to determine grain size distribution. A summary of Phase II Sampling Activities at Site P54 is provided as Table 1-30.

Table 1-30

PHASE II SAMPLING EFFORTS AT SITE P54 — ADDITIONAL BUNKERS 305, 307, AND 314

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	10	08/31/93 09/01/93 12/01/93	Samples were collected to assess each bunker as a possible contaminant sources.
	1	08/31/93	A geotechnical sample was collected at location E3-P54-S05 to characterize the nature of surface soils.

Source: Ecology and Environment, Inc. 1994.

Surface Soil Sampling

The five bunkers listed below were arbitrarily chosen from the fourteen bunkers located nearest the three original Site P54 bunkers that have not yet been investigated as part of the SIs for Sites P16 and P41. Two samples were collected from each of the five bunkers. The sampling locations in the runoff channels which have formed below the two drains that flank the metal door of each bunker, were intended to provide data to assess the potential for each of the bunkers to act as a contaminant source. The five bunkers and corresponding sample locations are listed below.

- Bunker 304: E3-P54-S01 and E3-P54-S02;
- Bunker 301: E3-P54-S03 and E3-P54-S04;
- Bunker 318: E3-P54-S05 and E3-P54-S06;
- Bunker 311: E3-P54-S07 and E3-P54-S08; and

- Bunker 312: E3-P54-S09 and E3-P54-S10.

In addition to analysis for contaminants, sample E3-P54-S04 was also analyzed for grain size. In order to follow QA/QC protocols approved in the QAPjP, a second set of surface soil samples were collected in December 1993 and analyzed for BNAs only.

1.2.7.7 Nature and Extent of Contamination

A summary of the detections above preliminary levels is provided in Table 1-31. A summary of the analytical data for all samples collected at Site P54 is provided in Table 1-32 following Section 1.2.7.8, Conclusions and Recommendations. Five comparison bunkers were chosen from the pool of fourteen bunkers in the vicinity of the original Site P54 bunkers (305, 307, and 314). The results of analysis of soil samples collected from the five comparison bunkers (Bunkers 301, 304, 311, 312, and 318) show potential arsenic contamination at three out of five of the bunkers. Arsenic was not found above background by OHM in sampling of the original three bunkers (305, 307, and 314) that make up Site P54. The highest concentrations of arsenic in soil samples from Bunker 301 (32.0 μg/g), Bunker 311 (76.0 μg/g), and Bunker 312 (200 μg/g) were above the soil screening level of 30 μg/g (MCP GW-1/S-1 and GW-3/S-3). Of the eleven bunkers sampled as part of investigations of Sites P16, P41, and P54, arsenic has been found above the highest level in background soils (10 μg/g), and the soil screening level (30 μg/g) at six bunkers. None of the five comparison bunkers for Site P54 were identified in interviews or file research as having been used for chemical storage. Apart from ammunition storage in the early years of the Annex, the only notable items stored in any of the five comparison bunkers were the storage of smoke grenades in Bunker 311, and medical supplies and equipment in Bunker 312. A history of bunker use for chemical storage does not correlate to high arsenic levels because although arsenic was detected at high levels at some of the bunkers not identified as chemical storage sites (Bunkers 304, 311, and 312) it was detected at low levels at some of the bunkers identified as used for chemical or chemical waste storage (Bunkers 305 and 307).

Several other metals including barium, chromium, cobalt, and nickel were also found at concentrations slightly above the highest levels in background soil samples, and copper, manganese, and potassium were found at levels nearly twice or more the highest level in background soils. None of the metals found in soils at the comparison bunkers, except arsenic, were higher than the soil screening levels.

The PAH compounds benzo(*a*)anthracene (1.00 μg/g), benzo(*a*)pyrene (0.800 μg/g), benzo(*b*)fluoranthene (1.00 μg/g), and chrysene (1.00 μg/g) were found at concentrations slightly above the screening level of 0.7 μg/g (MCP GW-1/S-1 and MCP GW-3/S-3) in one of two soil samples at Bunker 301. Benzo(*b*)fluoranthene (1.10 μg/g) was also found above the soil screening level at Bunker 312. Except for these compounds at Bunker 301 and 312, PAHs were detected below the screening level at all of the five comparison bunkers sampled.

Trace concentrations of pesticides were also detected in the soil samples taken at the five comparison bunkers. The highest concentration of the pesticide, lindane (0.008 μg/g), exceeded the highest background levels in soil but below any soil screening levels.

Table 1-31

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P54

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Maximum Concen-tration	Site ID	Frequency Above Screen Level
SOIL (μg/g)	Arsenic	10	30	MCP GW-1/S-1[1]	200 (est.)	E3-P54-S09	4/10
	Beryllium	0.446	0.4	MCP GW-1/S-1	0.45 (est.)	E3-P54-S02	1/10
	Benzo(*a*)anthracene	--	0.7	MCP GW-1/S-1	1.00 (est.)	E3-P54-S01	1/9
	Benzo(*a*)pyrene	--	0.7	MCP GW-1/S-1	0.80 (est.)	E3-P54-S01	1/9
	Benzo(*b*)fluoranthene	--	0.7	MCP GW-1/S-1	1.00	E3-P54-S10	2/9
	Chrysene	--	0.7	MCP GW-1/S-1	1.00	E3-P54-S01	1/9
	DDT	0.233	2	MCP GW-1/S-1	2.30	E3-P54-S07	1/10

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

DDT and its degradation products DDD and DDE were found in concentrations above highest background levels in soils in the samples from Bunkers 311, 312, and 318. The highest concentrations of DDT (2.30 μg/g), DDD (0.560 μg/g), and DDE (1.60 μg/g) were all found in one of the samples from Bunker 311. The DDT concentration at Bunker 311 was the only pesticide found in soil samples from the five comparison bunkers that exceeded the soil screening level of 2 μg/g (MCP GW–1/S–1). The highest concentrations of DDT (0.91 μg/g) and DDE (0.4 μg/g) in sampling conducted by OHM at the original three bunkers (305, 307, and 314) were below soil screening levels and the E & E results at Bunker 311. The concentration of DDD (0.61 μg/g) detected in previous sampling by OHM at Bunker 305 (the bunker alleged to have been used for chemical storage) was slightly above the highest level found at Bunker 311 by E & E.

No VOCs were found in any of the soil samples from the five comparison bunkers.

1.2.7.8 Conclusions and Recommendations

The results from soil sampling by E & E at the five arbitrarily selected comparison bunkers in the area west of Puffer Pond as part of the investigation of Site P54, in combination with previous sampling conducted at the three original Site P54 bunkers (305, 307, and 314), three bunkers in Site P16 (302, 306, and 309) and Bunker 303 in Site P41 indicate the presence of elevated levels of arsenic in soils outside half of the bunkers sampled. At bunkers investigated at Sites P16 and P54, arsenic levels were elevated at three out of six bunkers identified by interviewees as chemical or chemical waste storage areas, but were also elevated at three out of the five comparison bunkers which have no alleged or identified past use for chemical storage. While the source of the arsenic levels seems to be related to material that has flowed out the drains of the bunkers, the specific source of arsenic is unknown.

Some low level PAH contamination (at Bunkers 301 and 312) and DDT contamination (at Bunker 311) was also identified by sampling results. However, the DDT detection at Bunker 311 is much lower than that at the Pesticide/Herbicide Storage Bunker 303 (Site P41). No VOCs were detected at any of the comparison bunkers.

The highest detection of arsenic in soils at the bunkers investigated in Sites P16 and P54 was at Bunker 302 (270 $\mu g/g$) which is part of Site P16. Thus, it is recommended that an investigation be conducted at Bunker 302 as a test case to assess potential bunker-related arsenic contamination at both sites. The specific scope of this investigation is listed below:

- further soil sampling in the runoff path from Bunker 302 to determine the extent of arsenic contamination;
- wipe samples taken inside Bunker 302 along the drains to determine whether the bunker is the actual source of the arsenic;
- installation of one well at Bunker 302 to assess whether arsenic has migrated into groundwater.

All samples should also be tested for PAHs and pesticides to identify any potential migration of these compounds.

To clarify concerns at Site P54, it is recommended that further investigation following the Bunker 302 test case be conducted at Bunkers 301, 311, and 312 where arsenic, PAHs, and pesticides were detected above screening levels. The only concern identified to date at the original bunkers 305, 307, and 314 is that low levels of lindane and heptachlor epoxide exceed soil screening levels likely as a result of general pest management. No concerns were raised by analysis of results at the comparison Bunkers 304 and 318 and these bunkers should not be considered part of Site P54. Thus, Site P54 should be updated to include only six bunkers, 301, 305, 307, 311, 312, and 314.

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

Test	Parameter	E3-P54-S01 / SXP54011 / 09/01/93	E3-P54-S01 / SXP54011 / 09/10/93	E3-P54-S02 / SDP54022 / 12/01/93	E3-P54-S02 / SXP54021 / 09/01/93	E3-P54-S02 / SXP54022 / 12/01/93	E3-P54-S03 / SXP54031 / 09/01/93
TAL METAL	Aluminum	6820			8550		6500
	Antimony	0.331 BJ			< 0.500 J		< 0.500 J
	Arsenic	6.65 J			6.54 J		15.0 J!
	Barium	22.6			26.1 !		26.3 !
	Beryllium	0.329 J			0.450 J!@		0.263 J
	Calcium	756			639		539
	Chromium	17.3 !			17.0 !		16.8 !
	Cobalt	7.75 !			6.87 !		6.19 !
	Copper	10.9 !			12.4 !		13.5 !
	Iron	12000			12000		13000 !
	Lead	24.0 J			19.0 J		17.0 J
	Magnesium	2270			3010 !		2890 !
	Manganese	205 !			135 !		135 !
	Mercury	0.084 J			0.107		0.084 J
	Nickel	15.2 !			13.1 !		12.6 !
	Potassium	892 !			1540 !		1390 !
	Thallium	< 0.500			< 0.500		< 0.500
	Vanadium	16.1			22.3		18.9
	Zinc	40.2 J			30.5 J		22.3 J
TCL BNA	16MHME				0.092		0.160
	Anthracene	0.300 J		< 0.330	< 0.330	< 0.330	< 0.330
	BEPYR	0.800					
	BETAPN						0.072
	BJFANT						
	Benzo(a)anthracene	1.00 J@		< 0.330	< 0.330	< 0.330	0.150 J
	Benzo(a)pyrene	0.800 J@		< 0.330	< 0.330	< 0.330	0.180 J
	Benzo(b)fluoranthene	1.00 J@		0.071 J	< 0.330	0.086 J	0.370

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low. # = Exceeds ecological screening value
K= Result bias high. R= Result rejected. @= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S01	E3-P54-S01	E3-P54-S02	E3-P54-S02	E3-P54-S02	E3-P54-S03
	Field Sample ID	SXP54011	SXP54011	SDP54022	SXP54021	SXP54022	SXP54031
	Sample Date	09/01/93	09/10/93	12/01/93	09/01/93	12/01/93	09/01/93
Test	Parameter .						
TCL BNA	Benzo(ghi)perylene	0.500 J		< 0.330	< 0.330	< 0.330	0.160 J
	Benzo(k)fluoranthene	0.700 J		< 0.330	< 0.330	< 0.330	0.140 J
	Bis(2-ethylhexyl)phthalate	< 2.00		0.077 J	< 0.330	< 0.330	< 0.330
	C15AME						0.081
	Chrysene	1.00 J@		< 0.330	< 0.330	< 0.330	0.210 J
	Dibenzo(a,h)anthracene	< 2.00		< 0.330	< 0.330	< 0.330	< 0.330
	EMLIN				0.120		
	Fluoranthene	4.00		0.110 J	< 0.330	0.140 J	0.190 J
	HEDODA						
	Indeno(1,2,3-cd)pyrene	0.500 J		< 0.330	< 0.330	< 0.330	0.180 J
	LINOLA			0.460			
	Phenanthrene	0.600 J		< 0.330	< 0.330	0.076 J	< 0.330
	Pyrene	4.00		0.097 J	< 0.330	0.120 J	0.260 J
	TMBHPO						
TCL Pest	Aldrin	< 0.002			< 0.002		0.001 JU
	Endosulfan,B	0.002 U			0.001 JU		0.001 JU
	Endrin	< 0.002			0.002 BU		< 0.002
	Heptachlor Epoxide	0.000 BJC			< 0.002		0.001 BJC
	Lindane	< 0.002			< 0.002		0.001 JU
	Methoxychlor	< 0.020			0.019 JC		< 0.020
	P,P-DDD	0.007 U			0.013 C		0.005 C
	P,P-DDE	0.026 C			0.029 C		0.006 C
	P,P-DDT	0.037 C			0.050 C		0.018 C
	alpha-Chlordane	< 0.002			< 0.002		< 0.002
	gamma-Chlordane	< 0.002			< 0.002		< 0.002
TCL VOA	ALPHPN						
	TMBHPE						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S01	E3-P54-S01	E3-P54-S02	E3-P54-S02	E3-P54-S02	E3-P54-S03
	Field Sample ID	SXP54011	SXP54011	SDP54022	SXP54021	SXP54022	SXP54031
	Sample Date	09/01/93	09/10/93	12/01/93	09/01/93	12/01/93	09/01/93
Test	Parameter .						
TOC	Total Organic Carbon	33800			20200		16900

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S04	E3-P54-S05	E3-P54-S06	E3-P54-S07	E3-P54-S08	E3-P54-S09
	Field Sample ID	SXP54041	SXP54051	SXP54061	SXP54071	SXP54081	SXP54091
	Sample Date	09/01/93	08/31/93	08/31/93	08/31/93	08/31/93	08/31/93
Test	Parameter .						
TAL METAL	Aluminum	6910	4090	4380	4970	5320	5350
	Antimony	0.539 B!	0.433 BJ	0.318 BJ	3.17 J!	0.353 BJ	0.894 K!
	Arsenic	32.0 J!@	13.0 J!	4.76 J	76.0 J!@	20.0 J!	200 J!@
	Barium	16.5	14.8	13.4	24.0	12.7	24.1
	Beryllium	0.301 J	0.223 J	0.219 J	0.252 J	0.275 J	0.261 J
	Calcium	631	358 J	588	< 500	< 500	375 J
	Chromium	18.4 !	11.6	10.9	13.9	7.86	10.1
	Cobalt	6.23 !	5.57	3.91	3.60	2.83	4.76
	Copper	12.1 !	8.88	21.4 !	10.0	5.74	11.6 !
	Iron	13000 !	6780	5580	6340	5570	8600
	Lead	33.0 J	39.0 J	33.0 J	76.0 J	31.0 J	29.0 J
	Magnesium	2920 !	1500	1070	870	775	1530
	Manganese	103 !	160 !	182 !	112 !	71.9	98.0 !
	Mercury	0.107	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
	Nickel	13.1 !	11.6 !	9.68	8.97	8.86	10.5
	Potassium	1150 !	756 !	485 K	326 K	313 K	1210 !
	Thallium	< 0.500	< 0.500	< 0.500	0.156 J	< 0.500	0.324 J
	Vanadium	21.6	12.3	10.8	10.8	10.0	13.7
	Zinc	26.1 J	17.4	25.0	37.2	18.3	19.0
TCL BNA	16MHME						
	Anthracene		< 0.330	< 0.330	0.043 J	< 0.330	< 0.330
	BEPYR						
	BETAPN						
	BJFANT						0.091
	Benzo(a)anthracene		< 0.330	< 0.330	0.130 J	0.050 J	< 0.330
	Benzo(a)pyrene		< 0.330	< 0.330	0.170 J	0.057 J	< 0.330
	Benzo(b)fluoranthene		0.068 J	0.061 J	0.460	0.150 J	0.180 J

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low. K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S04	E3-P54-S05	E3-P54-S06	E3-P54-S07	E3-P54-S08	E3-P54-S09
	Field Sample ID	SXP54041	SXP54051	SXP54061	SXP54071	SXP54081	SXP54091
	Sample Date	09/01/93	08/31/93	08/31/93	08/31/93	08/31/93	08/31/93
Test	Parameter .						
TCL BNA	Benzo(ghi)perylene		< 0.330	< 0.330	0.160 J	< 0.330	0.100 J
	Benzo(k)fluoranthene		< 0.330	< 0.330	0.160 J	< 0.330	< 0.330
	Bis(2-ethylhexyl)phthalate		< 0.330	0.100 BJ	< 0.330	0.083 BJ	0.081 BJ
	C15AME						
	Chrysene		< 0.330	< 0.330	0.360	0.120 J	0.100 J
	Dibenzo(a,h)anthracene		< 0.330	< 0.330	< 0.330	< 0.330	< 0.330
	EMLIN						
	Fluoranthene		0.071 J	0.089 J	0.380	0.140 J	0.100 J
	HEDODA					0.086	
	Indeno(1,2,3-cd)pyrene		< 0.330	< 0.330	0.180 J	< 0.330	0.110 J
	LINOLA				1.40		
	Phenanthrene		< 0.330	0.063 J	0.210 J	0.072 J	< 0.330
	Pyrene		0.079 J	0.088 J	0.510	0.160 J	0.160 J
	TMBHPO						
TCL Pest	Aldrin	< 0.002	0.001 JC	0.000 JC	0.001 JC	0.001 JC	0.001 JC
	Endosulfan,B	0.007 U!	0.002 JU	0.004 C	0.008 U!	0.003 U	< 0.002
	Endrin	< 0.002	0.003 U	0.009 U!	< 0.002	0.005 C	< 0.002
	Heptachlor Epoxide	0.001 BJC	< 0.002	0.001 JC	0.001 JC	0.001 JC	< 0.002
	Lindane	< 0.002	< 0.020 U	0.008 C!	0.002 JU	0.001 JU	0.001 JU
	Methoxychlor	< 0.020	0.006 JU	< 0.020	0.030 U	0.015 JU	< 0.020
	P,P-DDD	0.026 C	0.097 C!	0.240 C!	0.560 C!	0.180 C!	0.040 C
	P,P-DDE	0.057 C	0.220 C!	0.300 C!	1.60 C!	0.840 C!	0.100 C
	P,P-DDT	0.088 C	0.360 C!	0.850 C!	2.30 C!@	0.940 C!	0.083 C
	alpha-Chlordane	0.000 JU	0.001 JC	0.002 JC	0.004 U	0.002 JU	0.001 JU
	gamma-Chlordane	< 0.002	0.001 JC	0.002 JC	< 0.002	< 0.002	< 0.002
TCL VOA	ALPHPN	0.140					
	TMBHPE	0.310					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

= Exceeds ecological screening value

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.

C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S04	E3-P54-S05	E3-P54-S06	E3-P54-S07	E3-P54-S08	E3-P54-S09
	Field Sample ID	SXP54041	SXP54051	SXP54061	SXP54071	SXP54081	SXP54091
	Sample Date	09/01/93	08/31/93	08/31/93	08/31/93	08/31/93	08/31/93
Test	Parameter .						
TOC	Total Organic Carbon	35500	21200	27100	21100	21400	15800

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S10					
	Field Sample ID	SXP54101					
	Sample Date	08/31/93					
Test	Parameter						
TAL METAL	Aluminum	4040					
	Antimony	1.64 J!					
	Arsenic	120 J!@					
	Barium	17.9					
	Beryllium	0.215 J					
	Calcium	< 500					
	Chromium	8.24					
	Cobalt	3.26					
	Copper	10.3					
	Iron	6800					
	Lead	45.0 J					
	Magnesium	1100					
	Manganese	62.4					
	Mercury	< 0.100					
	Nickel	11.4 !					
	Potassium	816 !					
	Thallium	0.207 J					
	Vanadium	14.2					
	Zinc	18.0					
TCL BNA	16MHME						
	Anthracene	0.072 J					
	BEPYR						
	BETAPN						
	BJFANT						
	Benzo(a)anthracene	0.230 J					
	Benzo(a)pyrene	0.300 J					
	Benzo(b)fluoranthene	1.10 @					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S10					
	Field Sample ID	SXP54101					
	Sample Date	08/31/93					
Test	Parameter .						
TCL BNA	Benzo(ghi)perylene	0.310 J					
	Benzo(k)fluoranthene	0.390					
	Bis(2-ethylhexyl)phthalate	< 0.330					
	C15AME						
	Chrysene	0.620					
	Dibenzo(a,h)anthracene	0.087 J					
	EMLIN						
	Fluoranthene	0.590					
	HEDODA						
	Indeno(1,2,3-cd)pyrene	0.450					
	LINOLA	0.400					
	Phenanthrene	0.190 J					
	Pyrene	0.860					
	TMBHPO	0.094					
TCL Pest	Aldrin	< 0.002					
	Endosulfan,B	0.012 U!					
	Endrin	< 0.002					
	Heptachlor Epoxide	0.002 JC!					
	Lindane	0.002 JU					
	Methoxychlor	< 0.020					
	P,P-DDD	0.170 C!					
	P,P-DDE	0.250 C!					
	P,P-DDT	0.670 C!					
	alpha-Chlordane	0.002 JU					
	gamma-Chlordane	< 0.002					
TCL VOA	ALPHPN						
	TMBHPE						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-32
Chemical Summary Report For Surficial Soils
Site: P54
Units: UGG

	Site ID	E3-P54-S10					
	Field Sample ID	SXP54101					
	Sample Date	08/31/93					
Test	Parameter .						
TOC	Total Organic Carbon	33700					

Source: USAEC IRDMIS Level 3/E & E, 1994

1.2.8 Site P56 — Cleared Area South of Bunker 313

Site P56, a cleared area south of Bunker 313, was identified through a review of aerial photographs (OHM 1992). Facility maps and file reviews did not reveal any evidence of activity at this area. Figure 1-9 provides an area map.

1.2.8.1 Site Location

Site P56 is located approximately 800 feet northwest of Puffer Pond and southeast of Bunker 313. Bunker 313 is surrounded by forest but opens on its southern side to a large clearing and access road. Wooden debris and some metal cables have been deposited in the clearing. Directly south of the bunker there is a network of larger clearings all connected by a dirt road which leads to Puffer Pond Road. These larger clearings show evidence of human activity; the ground is uneven and many areas appear to have been covered with sandy fill. In the large clearing southeast of the bunker, a 1-inch-thick insulated cable can be seen emerging from the ground.

1.2.8.2 Physical Characteristics

Site P56 is located on an outwash plain of sand and gravel between wetlands to the west and east, and Puffer Pond to the southeast. Surface elevations at the site range from 195 to 200 feet AMSL. Three test pits excavated at the site confirmed outwash material consisting of a silty sand with minor clay to a maximum depth of 5.5 feet. No geotechnical samples were collected at the site. Depth to bedrock is unknown, but the underlying material is projected to be the Marlboro Formation (Hansen 1956).

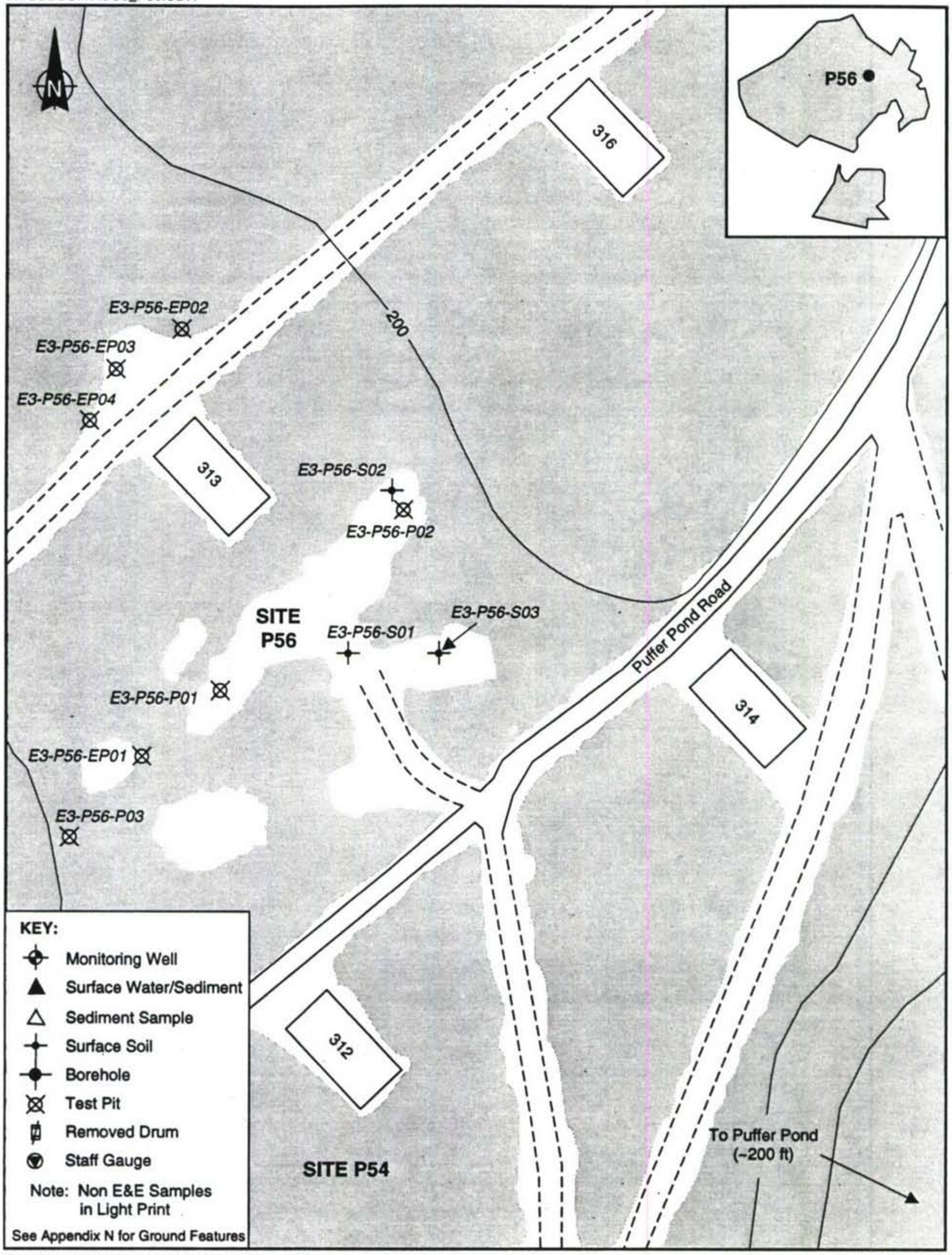
Surface water flows southwest from the site into the adjacent wetland. No wells were installed at Site P56; however, at test pit location E3–P56–P03, southwest of Bunker 313, groundwater was encountered at 5 feet BGS. Direction of groundwater flow is unknown but from the topography can be assumed to be either northeast or northwest to the adjacent wetlands which drain into Taylor Brook.

1.2.8.3 Ecological Characterization

Bunker 313 is surrounded on three sides by a dense, white pine and oak forest. The southern side opens to a large clearing and access road. The forest includes white pine, pitch pine, red oak, and red maple trees that range in height from 40 to 60 feet (LFS 1983).

Based on the general topography of the area, it appears that most of the surface water runoff from Site P56 flows southwest toward a seasonally saturated wetland vegetated with deciduous trees located approximately 500 feet west of the site. In addition, Puffer Pond, an open-water wetland is located approximately 500 feet southeast of the site and may be a receptor of surface water. Finally, Bunker Corner Pool, a vernal pool located approximately 1,000 feet south of the site, may receive surface water from Site P56.

11: SUDBURY\UC6_P56.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 1-9 MAP OF SITE P56
CLEARED AREA SOUTH OF BUNKER 313

In general, this area combines three productive habitats: upland forest, forested wetland, and open water. Oak acorns and pine seeds are consumed by many species of upland gamebirds, songbirds, small mammals, and by deer (Martin *et al.* 1951). The dense canopy closure of this type of forest also provides shelter to deer and rabbit during the winter. The thick mat of fallen oak and red maple leaves provides shelter and food to many species of amphibians and reptiles. Forested wetlands combine the shelter, water availability, and nutrient abundance to create a habitat which is attractive to aquatic and semi-aquatic wildlife as well as numerous upland species. Finally, the open water areas, the vernal pools and especially larger areas like Puffer Pond, are very valuable to wildlife. A variety of amphibians, reptiles, and waterfowl occur predominantly in the shallow portions of the pond, while piscivorous birds and raptors feed on fish throughout the pond. In summary, a variety of aquatic, semi-aquatic, and upland species live, breed and feed in this area.

Spotted salamanders (*Ambystoma laterale*), a Massachusetts species of special concern, were observed nesting in Bunker Corner Pool (Butler 1992). No unique habitats have been identified near the site (NHESP 1992).

1.2.8.4 Site History

A clearing is apparent to the south of Bunker 313 in an aerial photograph from 1944. The clearing is also present in 1952 and 1963 aerial photographs. However, in aerial photographs from 1978 and 1982, the area was apparently revegetating.

In 1964, Bunker 313 was used by Fort Devens for storage of ammunition. In 1973, the bunker was being used by the supply office of Natick, and for Civil Defense (whether for supplies or as a shelter is unknown). In 1977 the bunker was still used by the Natick supply office but was vacant at the time of the inspection and was also vacant at the time of the 1982 inspection. In 1992, the bunker was used by the U.S. Army Reserves and contained refrigerators in large crates. No staining was apparent in the bunker in 1992.

In 1992, a number of clearings were visible during the site reconnaissance southeast of the bunker. In the largest clearing, the ground was undulated and some metal cable protruded above the ground. A path was noted as entering the clearing from the road across from Bunker 312.

1.2.8.5 Result of Previous Investigations

Site P56 was identified as a cleared area, located to the east of Bunker 313 during a site walkover conducted by OHM in 1992. In the northern part of the large clearing east of Bunker 313, an area of disturbed soil was discovered; a metal cable protruding from the ground was also noted.

1.2.8.6 Field Work Performed

Analytical Parameters

All samples collected during the E & E investigation in 1993 were analyzed for TCL organics, TAL metals, and TPHC. A summary of Phase II Sampling Activities at Site P56 is provided as Table 1-33.

Table 1-33

PHASE II SAMPLING EFFORTS AT SITE P56 — CLEARED AREA SOUTH OF BUNKER 313

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Subsurface Soils	6	09/20/93	The samples were collected to investigate whether the cleared areas were previously used for disposing of unknown wastes.
Surface Soils	3	08/31/93	Samples were collected to investigate possibility that cleared areas were used for previous dumping of unknown wastes.

Source: Ecology and Environment, Inc. 1994.

Geophysical Investigations

To investigate any anomalies due to subsurface debris, an electromagnetic reconnaissance survey (EM31) was performed at the four clearings located southeast of Bunker 313. Survey results show no significant anomalies associated with any of the clearings.

Surface Soil Sampling

A total of three surface soil samples were collected from four clearings identified in aerial photographs and located behind and to the southeast of Bunker 313. The samples were collected from the center of three of the clearings to investigate the possibility that the areas were previously used for the disposal of unknown wastes.

Subsurface Sampling

Three pits were dug to investigate the possibility that the areas had been previously used for the subsurface disposal of unknown wastes. The test pits were dug using a backhoe to depths of approximately six feet BGS. Two of the pits (E3-P56-P01 and E3-P56-P02) were completed in two of the four clearings identified from aerial photographs behind Bunker 313. A third test pit (E3-P56-P03) was completed in a clearing along the western edge of the bunker accessible from the road running in front of Bunker 313. Each of the three pits had samples collected from one to two feet BGS and five to six feet BGS intervals. No unusual debris was encountered and the Organic Vapor Analyzer (OVA) used in the field did not measure any levels above background in any of the pits.

After completion of the three initial test pits, an additional three exploratory pits were completed. These pits were not in the original work plan but were added to investigate the possibility that the cleared areas had previously been used for the subsurface disposal of unknown wastes. In addition, the exploratory pits were used to investigate other areas directly in front of Bunker 313, where half-buried surface debris was located. No evidence was found in any of the three exploratory test pits which would indicate the past disposal of debris.

1.2.8.7 Nature and Extent of Contamination

Analysis of the surface and subsurface soil samples taken at Site P56 did not indicate any contamination at the site caused by buried debris. Contaminants were not found at Site P56 in surface or subsurface soil above soil screening levels. Several metals including aluminum, cadmium, and manganese were found in some of the subsurface soil samples at concentrations slightly above the highest levels in background soil samples, but were still below soil screening levels. TPHCs (13.3 μg/g, estimated) were found in one subsurface soil sample, also well below the soil screening value of 500 μg/g (MCP GW-1/S-1). No VOCs were detected in subsurface soil samples at Site P56.

Analysis of the three surface soil samples did not detect any metals or pesticides in concentrations above the highest levels in background soil samples, except aldrin (0.006 μg/g) in one sample at a concentration that was well below the soil screening level of 0.03 μg/g (MCP GW-1/S-1 soil value). No volatile compounds were detected in surface soils.

A summary of the analytical results for Site P56 is presented in Tables 1-34 and 1-35.

1.2.8.8 Conclusions and Recommendations

The initial concern at Site P56 was that the appearance of uneven ground and surficial debris might indicate subsurface debris that would contribute to contamination at the site. Test pit excavations (and soil borings) at the site did not encounter any buried debris or other signs of contamination. Analysis of surface and subsurface soil samples did not indicate any evidence of chemical contamination in soils at the site.

Given that no physical or chemical evidence of contamination has been found at this site, it is recommended that no further action be conducted at Site P56.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 1-34
Chemical Summary Report For Subsurface Soils
Site: P56
Units: UGG

Test	Parameter	E3-P56-B01	E3-P56-B01	E3-P56-B02	E3-P56-B02	E3-P56-B03	E3-P56-B03
	Field Sample ID	EXP56011	EXP56012	EXP56021	EXP56022	EXP56031	EXP56032
	Sample Date	09/20/93	09/20/93	09/20/93	09/20/93	09/20/93	09/20/93
	Depth	1.5 ft.	5.5 ft.	1.0 ft.	5.5 ft.	1.0 ft.	5.5 ft.
TAL METAL	Aluminum	7650	2920	6860	413000 !@	12800 !	5780
	Antimony	0.281 J	< 0.500	< 0.500	0.324 J	< 0.500	0.307 J
	Arsenic	4.94	2.95	4.33	6.18	4.02	2.27 K
	Barium	18.2	9.94	10.9	14.9	7.28	25.0
	Beryllium	0.288 JL	0.132 JL	0.283 JL	0.181 JL	0.316 JL	0.261 JL
	Cadmium	0.779 !	0.308 J	0.498 J	0.424 J	0.773 !	0.799 !
	Calcium	145 J	396 J	95.1 J	588	< 50000	1160
	Chromium	10.1	5.41	8.59	7.22	9.26	11.1
	Cobalt	4.91	2.90	3.80	4.16	3.60	4.88
	Copper	7.12 L	5.20 L	4.24 L	5.67 L	2.88 L	8.45 L
	Iron	10300	5400	7520	6880	8810	8410
	Lead	20.0 J	1.51 B	7.22 B	3.16 B	5.83 B	2.84 B
	Magnesium	142000 !	105000 !	108000 !	127000 !	72800 !	204000 !
	Manganese	116 !	56.4	75.6	88.8	36.8	81.7
	Nickel	10.5	5.93	7.52	6.65	6.34	10.7
	Potassium	189 BJ	472 K	217 BJ	646 !	112 BJ	1290 !
	Selenium	0.258	< 0.200	< 0.200	< 0.200	0.233 J	< 0.200
	Thallium	0.110 J	0.071 J	0.099 J	< 0.500	0.124 J	0.096 J
	Vanadium	13.1	5.89	10.1	8.64	11.8	12.8
	Zinc	26.1 J	23.6 KJ	44.4 J	18.2 KJ	21.4 KJ	31.3 J
TCL Pest	Endosulfan,A	< 0.002	< 0.002	0.000 JC		0.001 JU	< 0.002
TPHC	Total Petroleum Hydrocarbons	13.3 J	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

\# = Exceeds ecological screening value

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low. @= Exceeds human health screening value.
K= Result bias high. R= Result rejected. != Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 1-35
Chemical Summary Report For Surficial Soils
Site: P56
Units: UGG

Test	Site ID	E3-P56-S01	E3-P56-S02	E3-P56-S03			
	Field Sample ID	SXP56011	SXP56021	SXP56031			
	Sample Date	08/31/93	08/31/93	08/31/93			
Test	Parameter .						
TAL METAL	Aluminum	4210	5690	3120			
	Arsenic	6.29	6.88	5.88			
	Barium	10.6	8.84	4.72 J			
	Beryllium	0.220 J	0.278 J	0.133 J			
	Chromium	8.52	6.06	1.79 J			
	Cobalt	3.12	2.32	1.57			
	Copper	5.04	3.94	2.58			
	Iron	4560	5050	2700			
	Lead	9.08	17.0	11.2			
	Magnesium	824	493 J	252 . J			
	Manganese	72.9	56.6	33.2			
	Nickel	8.55	7.71	7.12			
	Potassium	456 K	143 BJ	130 BJ			
	Selenium	< 0.200	0.228	0.214			
	Vanadium	9.00	9.16	6.86			
	Zinc	11.7	8.06	6.31			
TCL Pest	Aldrin	< 0.002	0.006 C	0.002 C			
	Endosulfan,B	0.001 JU	0.002 JC	< 0.002			
	P,P-DDD	0.056 C	0.005 U	0.004 U			
	P,P-DDE	0.078 C	0.011 CK	0.006 KC			
	P,P-DDT	0.140 C	0.018 C	0.011 CK			
TPHC	Total Petroleum Hydrocarbons	59.1	45.2	43.0			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

2. WATERSHED 1B — LOWER TAYLOR BROOK

2.1 WATERSHED DESCRIPTION AND ASSESSMENT

Proposed investigative activities for the sites identified at the Annex have been determined through a review of previous activities and findings, and are governed by the established SOW. The objectives of the activities are to determine whether contamination is present in groundwater, surface water, sediment, or surface/subsurface soils at the assigned Phase II sites, and, in the cases where contamination is thought or known to exist, to confirm and better characterize its nature and extent.

To evaluate each site, and to develop a better understanding of the site's impact on the Annex environment, the Annex has been divided into seven distinct watersheds. In this report, the general findings of the field effort are first summarized for each watershed as a whole. Detailed information about activities undertaken and sampling results is then provided for each site. Conclusions and recommendations are reviewed and discussed in conjunction with the findings of the Phase I investigation conducted by OHM. Data results are provided with each site investigation section. The methodology used in the screening of analytical results generated through this Phase II SI, and the screening values used to identify areas of possible concern, are fully explained in Section 7, Volume I of this report. The appendices provide field reports, special studies, and QA/QC results used throughout this report.

The sites investigated by E & E in Watershed 1B are depicted on Figure 2-1. For ease of reference, Table 2-1 provides a list of these sites with their current status.

Table 2-1

WATERSHED 1B SITES

Site Number	Site Name	Current Status
A1	Decontaminated Mustard Area	Limited Site Investigation
A2	Demolition Ground I	Site Investigation
P11	Building T405 Area	Remedial Investigation
P13	Massachusetts Fire Fighting Academy	Remedial Investigation
P23	Building T465 (Drums)	Site Investigation
P26	Air Drop Zone Clearing	Site Investigation
P42	Off-Site Dump	Site Investigation
P45	Burned Area by Outside Fence	Site Investigation

Source: Ecology and Environment, Inc. 1994.

2.1.1 Watershed Location and Description

Watershed 1B — Lower Taylor Brook consists of the catchment area drained by Taylor Brook from just south of its junction with Honey Brook to its mouth at the Assabet River, including the catchment areas of two tributaries. One area is drained by a small unnamed tributary from the northeast originating near Green Meadow School in Maynard. The other, larger area, lying to the southeast is drained by Honey Brook. Honey Brook originates in a wetland south of the USAF weather radar laboratory and between the hills of ground moraine and bedrock, one in the center of the Annex and the other on which the laboratory is built. Honey Brook also drains the area between the laboratory and an unnamed hill formed by a drumlin aligned north-south just south of Tuttle Hill.

Within this watershed, E & E investigated Sites A1, A2, P11, P13, P23, P26, P42, and P45. Sites P11 and P13 are adjacent and, while they lie within the edge of the watershed according to surface water flow, a seismic survey and monitoring well installation program have revealed that the groundwater divide bisects the site, causing the northern half of Site P11/P13 to fall into Watershed 3.

Other watershed boundaries lie along the crests of ridges, but the boundary within the wetland at the headwaters of Honey Brook is poorly defined and may even shift slightly in response to uneven precipitation. Honey Brook itself has an unnaturally straight segment adjacent to the Taylor Drop Zone (Site 26), where it has been channelized and deepened to provide more rapid drainage.

Watershed topography reflects both geology and hydrology, with hills of till over bedrock, both of which are of lower hydraulic conductivity than the intervening outwash plains. Runoff and groundwater discharging down the slopes of the hills enters the outwash and becomes shallow groundwater. This then discharges to the streams and wetlands and exits the watershed via Taylor Creek to the Assabet River. With the exception noted above at Site P11/P13, groundwater flows reflect topography. The outwash within the lower valley of Taylor Creek has been investigated by the Town of Maynard as a possible water supply, using both seismic surveys and drilling (Dufresne-Henry 1982). This report indicated that under approximately 20 feet of sand and gravel at the surface, lay brown silt and clay. Depths to bedrock were between 28 to 73 feet, with the average around 50 feet. The silt and clay were of "poor transmissivity" and are "not suitable for the development of a municipal water supply" (Dufresne-Henry 1982). Generalized groundwater flow and site-specific flow directions were determined from field observations of topography, drainage, and water level measurements collected on 13 September and 3 December 1993. Table 2-2 is a list of groundwater elevations as calculated from water level measurements collected during the September and December field events. Average groundwater elevations presented in the physical characteristics descriptions of each site are based on both sets of water level measurements.

WATERSHED 1B E&E SITES	
SITE NUMBER	SITE NAME
A1	DECONTAMINATED MUSTARD AREA
A2	DEMOLITION GROUND 1
P11	BUILDING T405 DUMP AREA
P13	MASSACHUSETTS FIRE FIGHTING ACADEMY
P23	BUILDING T465 (DRUMS)
P26	AIR DROP ZONE CLEARING
P42	OFFSITE DUMP
P45	BURNED AREA BY OUTSIDE FENCE

ecology and environment

Figure 2-1 WATERSHED 1B – LOWER TAYLOR BROOK

Table 2-2

**WATERSHED 1B — LOWER TAYLOR BROOK
WATER LEVEL MEASUREMENTS***

Site	Well	Water Levels**	
		09/13/94	12/03/94
P45	GZA-MW2	185.71	186.50
A1	EHA5	178.80	180.60
	DM-2	180.00	185.25
	DM-3	185.42	186.95
A2	EHA4	186.02	189.07
	E3-A2-M01	184.21	185.16
P11	E3-P11-M01	193.65	194.77
	OHM-P11-32	193.81	195.06
	OHM-P11-33	193.67	194.94
	OHM-P11-34	192.90	193.96
	EHA3	193.63***	196.42
P13	E3-P13-M01	195.29	194.51
	E3-P13-M02	197.17	196.62
	E3-P13-M03	197.34	198.09
	E3-P13-M04	193.77	194.75
P23	E3-P23-M01	183.84	184.59
P26	E3-P26-M01	189.19	191.33
	E3-P26-M02	189.28	189.48
	E3-P26-M03	188.98	188.68

*Includes data collected from OHM, Dames and Moore, AEHA, and GZA wells.
**All measurements are recorded in feet AMSL.
***Measured by OHM on June 12, 1992.

Source: Ecology and Environment, Inc. 1994.

2.1.2 Preliminary Watershed-Wide Assessment

In order to assess the overall impacts of the Annex on the surrounding environment, a watershed approach has been adopted. This approach divides the facility into areas draining to particular streams of surface water bodies, both by surface runoff (which is minimal at the Annex) and by groundwater flow. Within each watershed, the individual sites are potential sources of contaminants and the surface water and sediments are potential receptors or sinks. Movement of water through the Annex and the discharge of groundwater to surface water transports contaminants from the soil to groundwater and then to surface water and sediments. Sediment layers are often organic-rich with high TOC that can adsorb contaminants occurring in groundwater before they reach surface water. Any persistent toxics present in the groundwater discharge can accumulate in sediments and in biota living in the streams and

ponds. The result is that any accumulation of contaminants that has taken place at any of the sites within a given watershed tend to be concentrated in the sediments within the surface water draining the watershed and in surface water itself.

Analyzing results of sediment and surface water sampling at the Annex along a given drainage can provide information about where discharges from specific sites enter the surface water pathways. Samples taken at the point where drainages leave the Annex or join a larger stream allow an assessment to be made of the cumulative impact of a particular watershed. Sampling results were compared to background pond and stream levels and to preliminary screening values. Surface water screening values include water quality criteria regarding both human health and aquatic life, while sediment screening values are ecologically oriented. Surface water and sediment sampling results were also compared to site-specific groundwater and soil sampling results to attempt to identify potential sources of watershed contamination. Sampling results from previous investigations by Dames and Moore in 1984 and 1985, OHM in 1992 and 1993, and E & E in 1993 and 1994 have all been considered in the watershed assessments. The number of samples used for analysis of particular contaminants will vary depending on the analyte spectrum for each sample used in this assessment. Table 2-3 lists the locations of surface water and sediment samples in Watershed 1B which were used to develop this assessment.

Table 2-3

SURFACE WATER/SEDIMENT SAMPLE LOCATIONS IN WATERSHED 1B*

Site ID	Location
	Background
E3-BCK-D08	Northeast of Site P45, in tributary to Taylor Brook
	Tributary to Honey Brook
E3-P26-D03	Wetlands west of Site P26
FW1SD17/SW17	Tributary to Honey Brook, west of White Pond Road and Site P26
E3-P11-D01	Drainage from Site P11 to tributary to Honey Brook
E3-P11-D02	Tributary to Honey Brook, downstream of Site P11 and FWSD17/SW17
E3-P13-D03	Southeast drainage from Site P13 to tributary to Honey Brook
E3-P13-D02	Eastern drainage from Site P13 to tributary to Honey Brook
E3-P13-D01	Downstream of confluence of drainage from Site P13
E3-P13-D04	Tributary to Honey Brook, downstream of both Sites P11 and P13
E3-P13-D05	Tributary to Honey Brook, downstream of bridge from Site P26 to Puffer Road
	Honey Brook
E3-P26-D04	Honey Brook, west of Bunker 345, south of Site P26
E3-P26-D02	Honey Brook, west of Bunker 347, south of Site P26

Table 2-3 (continued)

SURFACE WATER/SEDIMENT SAMPLE LOCATIONS IN WATERSHED 1B*

Site ID	Location
	Honey Brook (continued)
P4SD1/SW1	Small tributary to Honey Brook from former drum location at Bunker 349 (Site P4)
E3-P26-D01	Honey Brook pond, east of Site P26
FW1SD9/SW9	Honey Brook pond, downstream of tributary from Site P11/P13
E3-P11-D03	Honey Brook, east of Puffer Road
FW1SD8/SW8	Honey Brook, east of Puffer Road, upstream of small pond
E3-BCK-D05	Honey Brook, just upstream of entry point into Taylor Brook
	Taylor Brook from Honey Brook to the Drainage from Site P45
SW/SED3	Taylor Brook, downstream of Honey Brook
FW1SD11/SW11	Taylor Brook, downstream of Honey Brook
	Drainage from Site P45
E3-P45-D01	Tributary to Taylor Brook, downstream of former drum location at Site P45
	Taylor Brook below P45 to Annex boundary at Site P42
A1SD1/SW1	Taylor Brook, downstream of tributary from Site P45
A1SD2/SW2	Taylor Brook, at south end of pond between Sites A1 and A2
A1SD3/SW3	Taylor Brook, at north end of pond between Sites A1 and A2
SW/SED1	Taylor Brook, north of Patrol Road
FW1SD10/SW10	Taylor Brook, north of Patrol Road
E3-P42-D01	Taylor Brook, just north of Annex boundary

*From upstream to downstream.

Source: Ecology and Environment, Inc. 1994.

2.1.2.1 Background Conditions

One background surface water and sediment sample (E3-BCK-D08) was collected in a tributary to Taylor Brook that flows from northeast of Site P45, into a small pond, under Patrol Road and into Taylor Brook south of Site A1. The background sample was collected from a point approximately 400 feet upstream of the small pond in an area upgradient of any part of Site P45. Analysis of the surface water sample at this point indicated arsenic (1.96 μg/L), iron (4810 μg/L) and lead (10.3 μg/L) at concentrations above screening levels. The levels of these metals are considered to be naturally occurring since the sample was taken in an area upgradient of any identified sites at the Annex and upgradient of any areas historically used by the Annex. The stream was observed to be clear, and free of any debris or other evidence of contamination. The pH of this water was 6.90 and turbidity was less than 1.0 Nephelometric Turbidity Units (NTUs). No organic compounds were found in the background sediment sample above screening levels. The results of sample analysis at this location and the sample analysis at the Cutting Pond outlet were compared. The higher level

detected of the two locations was chosen to establish background comparison values for use at the Annex. In Watershed 1B, this is particularly appropriate since Taylor Brook receives drainage from both background locations (see Section 6.2, Volume I).

2.1.2.2 Water Quality Parameters in Watershed 1B Waters

Surface waters in Watershed 1B range from highly acidic to slightly alkaline with pH ranging from 3.78 to 7.30. The drainages from Site P11 and Site P13 were particularly acidic with pHs of 3.78 in surface waters closest to the sites, and rising further downstream. This acidity may reflect the low-flow nature of these drainages and the highly organic soils in adjoining wetlands. Honey Brook is relatively less acidic with pHs ranging from 6.15 at a point west of Bunker 345, to 7.3 at the entrance into Taylor Brook. The only reading of pH on Taylor Brook in Watershed 1B by E & E was at Site P42 at the Annex boundary, which was 6.27. Total suspended solid (TSS) levels of surface water in Watershed 1B were not significantly elevated to the point that would indicate a large amount of sediment or suspended solids in the water, except at one sample in Honey Brook (180 NTUs at E3-P26-D04) and at the sample taken in the wetlands west of Site P26 (>1,000 NTUs at E3-P26-D03).

Organic carbon content of sediments in Watershed 1B ranged widely from a low of 1,020 μg/g to 592,000 μg/g, reflecting the variety of stream and wetland conditions found in the watershed. TOC content in the sample rises above 10 percent (100,000 μg/g) in the wetlands that drain Site P11, the wetlands below Site P13, the ponding area/wetland on Honey Brook northeast of Site P26, the wetlands at the confluence of Honey and Taylor Brooks, and in the small wetlands downgradient of Site P42. These areas of organic-rich sediment are likely to accumulate potential contaminants. The highest concentrations of most metals and all of the pesticides found in sediments in Watershed 1B above background and screening levels were indeed found at sample points where organic carbon content exceeded 10 percent.

2.1.2.3 Tributary to Honey Brook

Wetlands West of White Pond Road and Site P26

Analysis of the surface water and sediment samples (E3-P26-D03) taken in the wetland located west of White Pond Road and Site P26 and near some metal debris, indicated concentrations of lead in surface water and DDD in sediment at values above screening levels. The concentration of lead (3.83 μg/L) in surface water was above the screening level of 3.2 μg/L (MA/CWA WQC for protection of aquatic life), but was below the highest concentration in background streams of 10.3 μg/L. Arsenic was found in sediments above background levels, but below the screening level. In the sediment sample, DDD (0.007 μg/g) was slightly above the screening level of 0.002 μg/g (NOAA ERL). The DDD found here is probably a result of pest management practices that have taken place at the Annex, and the lead may be a natural level or related to runoff from White Pond Road.

No contaminants were found in the surface water and sediment samples (FW1SD17/SW17) taken on the tributary to Honey Brook just upstream of where the stream flows under White Pond Road at concentrations above background and screening levels.

Drainage from P11

Two surface water samples were taken in the runoff pathway for Site P11. Analysis of these samples indicated levels of arsenic (up to 1.98 μg/L, estimated), cadmium (1.46 μg/L), iron (2,800 μg/L), and lead (21.6 μg/L) above screening levels. The arsenic and iron concentrations, however, were below background levels, and are probably naturally occurring. Acetone (12.0 μg/L) was also found in this sample. However, given the high volatilization potential of acetone and that acetone was not found elsewhere at the site, the likely cause of this detection is laboratory contamination.

In analysis of two sediment samples taken in the runoff path to the south of Site P11, several metals were found in concentrations above background levels, but only lead in one sample was above sediment screening levels. A concentration of lead (34.0 μg/g) was found in the E3-P11-D01 sediment sample, which taken in the wetlands southwest of Site P11, was slightly above the screening level of 31 μg/g (Ontario MOE LEL). However, this level is below the NOAA ERL value of 35 μg/g and well below the NOAA ERM of 110 μg/g. Lead (17.1 μg/L) was found in unfiltered samples taken from one of the monitoring wells at Site P11 (E3-P11-M01), but not in the filtered sample. If the lead level is not naturally occurring, a possible source is runoff of petroleum products containing lead from Site P11/P13. DDT (in one sample), DDD (in one sample), and DDE (in both samples) were found in concentrations above the screening values for these compounds. In the P11 sediment samples, the highest concentrations of DDT (0.038 μg/g), DDD (0.100 μg/g), and DDE (0.079 μg/g) were all found at E3-P11-D02 and were slightly above NYSDEC sediment quality criteria (0.064 μg/g for both DDD and DDE) that were adjusted for the TOC content (63,800 μg/g or 6.38 percent) of this sediment sample. These pesticides probably reflect pest management practices rather than site-related contamination. TPHC (26.0 μg/g, estimated) were detected at E3-P11-D01 above background and the screening level of 2 μg/g (Ontario MOE LEL). This level probably reflects some low-level drainage of petroleum from Site P11/P13. TPHC was not detected in sediment samples taken further downstream from Site P11.

Drainage from Site P13

In surface water samples collected below Site P13 arsenic, iron, lead, and zinc were found at concentrations slightly above background levels, and also above screening values. Arsenic (up to 4.40 μg/L), iron (up to 5,100 μg/L), lead (up to 12.3 μg/L), and zinc (181 μg/L) were found at higher levels in samples taken closer to Site P13, declining to background levels further downstream. DDT and its degradation products DDD and DDE were also found in a surface water sample taken at the southeastern drainage from Site P13 (E3-P13-D03) at concentrations above background and screening levels. The DDT level at this sample point (0.263 μg/L) was also above the MA/CWA WQC for the protection of aquatic life of 0.001 μg/L. The concentrations of DDD and DDE at E3-P13-D01, which is downstream of E3-P13-D03, were lower than the upstream sample, and DDT was not

detected at this point. DDT, DDD, and DDE were not detected in water samples (E3-P13-D04 and E3-P13-D05) taken downstream from E3-P13-D03, indicating some limited surficial runoff containing these compounds from Site P13, with declining concentrations as distance increases from the site.

Analysis of sediment samples taken in the drainage from Site P13 indicated concentrations of several metals above background and screening levels (including cadmium, copper, iron, lead, nickel, and zinc) in the samples taken closer to the site (E3-P13-D03, E3-P13-D02, and E3-P13-D01), that decline to background levels in the samples taken further downstream (E3-P13-D04 and E3-P13-D05). One notable exception is the arsenic (37.0 μg/g) found at E3-P13-D04, just upstream of the bridge from Site P26 to Puffer Road, which is more than three times the highest upstream concentration of 11.2 μg/g (E3-P13-D01). The arsenic concentration at E3-P13-D04 and upstream were both above the screening value of 6 μg/g (Ontario MOE LEL). This may indicate some accumulation of arsenic in sediments downgradient from Site P13, but given that E3-P13-D04 is located downgradient of Site P26 and adjacent to a road crossing, the source of this arsenic concentration may not be related to Site P13. Sediment concentrations of cadmium, iron, and zinc were above screening levels only at sample point E3-P13-D03 (immediately southeast of the site) and copper, lead, and nickel were only above screening levels at E3-P13-D01 (downstream at the junction of two drainages from Site P13). In groundwater samples taken from Site P13 in the south side of the groundwater divide under the site, aluminum, iron, and manganese were the only metals found above screening levels in filtered samples, and manganese was the only metal found above screening levels in filtered samples. Thus, the source of elevated metals is more likely to be surficial runoff or debris in the drainages than groundwater discharge from Site P13. While several of these metals were found in soil samples at Site P13 above background, none were found above soil screening levels.

DDT and its degradation products DDD and DDE were found in all of the sediment samples taken downstream of Site P13 at concentrations above screening levels. The highest concentration of DDT (0.230 μg/g) was at E3-P13-D03, the sediment sample taken closest to Site P13 itself. The highest concentrations of DDD (0.760 μg/g) and DDE (0.540 μg/g) were found at E3-P13-D01, at the confluence of two drainages from the site, where the organic content (59.2 percent) was the highest in this stream. The concentrations of DDT, DDD, and DDD at points downstream of E3-P13-D01 decline, but were still above screening levels. No DDT was detected at the sediment sample (E3-P13-D05) taken the furthest downstream from Site P13, although DDD and DDE were still present. DDT (up to 0.226 μg/g), DDD (up to 0.59 μg/g), and DDE (up to 0.4 μg/g) were also detected in soil samples at Site P13, but at relatively low levels probably due to pest management practices rather than a spill or dumping of DDT containing material. These results indicate some low level migration of DDT and its breakdown products from the site, declining as distance increases from the site.

TPHC were found in sediments at sample points E3-P13-D03 (263 μg/g) and E3-P13-D01 (295 μg/g), but not at points further downstream, likely indicating some low level runoff from Site P13. A gasoline station at Building T410, the car fire training on the north side of Site P13, and the many USTs located at the site may be potential sources.

Contaminants found in the tributary to Honey Brook include arsenic and several other metals, DDT and its degradation products, and TPHC. The source of these contaminants appears to be runoff from Site P11/P13, although some impact may also be the result of pesticide applications at Site P26, or runoff from Puffer Road which runs along the eastern edge of this drainage. These contaminants appear to be accumulating in the sediments of the drainage immediately south of Site P13, with declining concentrations as one heads downstream toward Honey Brook.

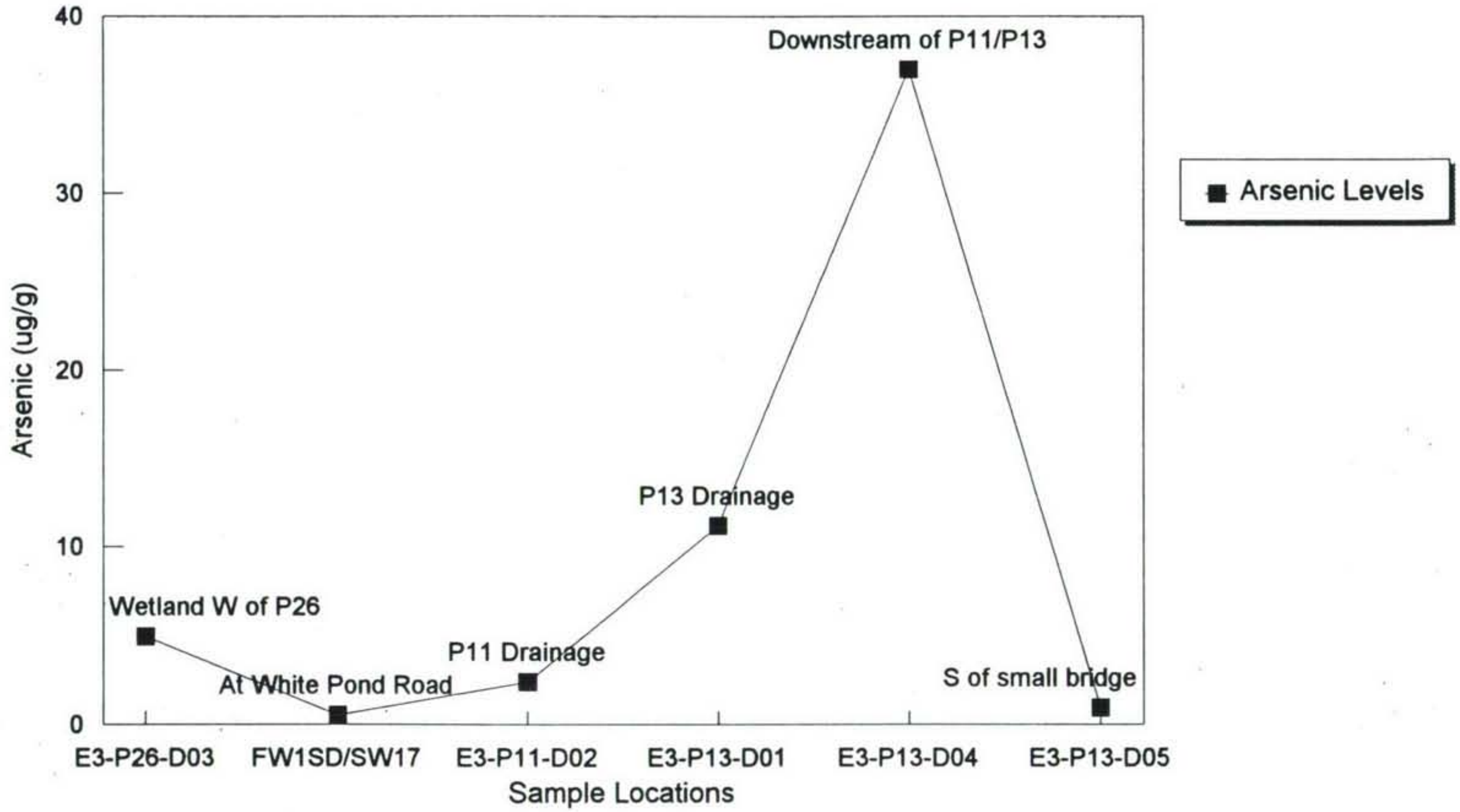
To illustrate the distribution of arsenic in sediments in this tributary, Graph 2-1 provides a profile of arsenic in sediments along the length of the stream from the wetland at its headwaters to Honey Brook.

2.1.2.4 Honey Brook

From West of Bunker 345 to Puffer Road

Analysis of surface water samples (E3-P26-D01, E3-P26-D02, and E3-P26-D04) taken east of P26 along Honey Brook indicated concentrations of arsenic above background and screening levels. The concentrations of arsenic were consistent over the three samples, with the minimum concentration of 7.18 μg/L at the E3-P26-D02 sample point west of bunker 345, and the highest of 8.89 μg/L found in the sample at E3-P26-D01 taken in the backwater area of Honey Brook northeast of Site P26. The arsenic level at the most upstream sampling point of these three samples was higher than the sample at E3-P26-D02 which is downstream. Arsenic was not found in filtered or unfiltered groundwater samples or in soil samples at Site P26. The pattern of surface water arsenic results seems to indicate that the arsenic source, is unrelated to Site P26. Honey Brook receives drainage from at least six bunkers located nearby and arsenic was detected at higher concentrations (13.2 μg/L) in a surface water sample (P4SW1), taken upstream of the ponded area of Honey Brook (E3-P26-D01) in the drainage from Site P4. This sample was taken to investigate runoff from a drum (now removed) at Site P4 that contaminated the soils under the drum with arsenic up to a level of 200 μg/g. Arsenic was not found in a surface water sample (FW1SW9) taken further downstream on Honey Brook below the tributary from Site P11/P13. No other contaminants were found in surface water samples from Honey Brook above both background and screening values.

Analysis of sediment samples from Honey Brook also indicated concentrations of arsenic above background and screening levels. However, the concentration of arsenic in sediment increased as one proceeds downstream toward the ponded area at Puffer Pond, with the concentration at the most upstream sample (2.15 μg/g at E3-P26-D04) being only slightly above background, increasing to 8.20 μg/g at E3-P26-D02, and then rising to 35.0 μg/g at E3-P26-D01. The sample at the pond area had a high organic carbon content (46.3 percent), which probably indicates that arsenic is sorbing onto the organic-rich sediments at this point in Honey Brook. At the sediment sample (P4SD1) taken in the drainage from Site P4, arsenic was also found (9.4 μg/g). Arsenic (4.9 μg/g) was found at a lower level further downstream from E3-P26-D01 in the sample FW1SD9 taken below the tributary from Site P11/P13.



Source: Data from Ecology & Environment, Inc., 1994; OHM, Inc., 1994
Compiled by Ecology & Environment, 1994

Graph 2-1 Arsenic Concentrations in Sediments in Tributary to Honey Brook

Chromium (38.1 μg/g) and copper (16.3 μg/g) were found in the FW1SD9 sample above background and screening levels.

Low concentrations of DDT, DDD, and DDE were found in sediments in Honey Brook at this point, with the highest concentrations (DDD at 0.120 μg/g, DDE at 0.060 μg/g, and DDT at 0.045 μg/g) found at E3-P26-D01, being above sediment screening values. However, the concentrations of these pesticides were well below NYSDEC SQC and EPA SQC criteria for these compounds at 0.463 μg/g for DDD and DDE (NYSDEC) and at 0.383 μg/g for DDT (EPA SQC), adjusted for the site-specific TOC content of this sample.

Below Puffer Road

In the surface water samples taken on Honey Brook downstream of Puffer Road, arsenic was the only compound found in concentrations above background and screening levels. Arsenic was found above background and screening levels at surface water samples taken just downstream of Puffer Road (7.01 μg/L at E3-P11-D03) and at the outlet from Honey Brook into Taylor Brook (4.69 μg/L at E3-BCK-D05), but not at the sample taken upstream of the small pond in the area of Honey Brook. The surface water and sediment data for the samples at E3-BCK-D05 are presented in Tables 2-4 and 2-5.

Sediment samples taken in this part of Honey Brook contained arsenic, PAHs and pesticides in concentrations above background and screening levels. Arsenic concentrations increased from Puffer Road (4.84 μg/g) to the Honey Brook outlet (8.72 μg/g). DDT, and its degradation product DDE, were found in the Puffer Road sediment sample in concentrations above background and screening values. DDD and DDE were also found in the sediment sample at the Honey Brook outlet at concentrations higher than those in the Puffer Road sample, probably due to sorption on the organic-rich sediments in wetlands at the confluence of Honey and Taylor Brooks.

In Honey Brook, the key potential contaminant is arsenic which was found in surface waters and sediments, particularly in samples taken near the bunkers located on the eastern side of Honey Brook, but also further downstream toward Taylor Brook. One arsenic source along Honey Brook has been identified as the drum removed from Site P4. Arsenic was found in surface water and sediment samples taken just downgradient of the former drum location. Given that arsenic was also found in soils at other bunkers at the Annex, the source of arsenic in Honey Brook in this area may be bunker-related. A more general source, such as the use of arsenic-based herbicides for weed control along roads or around bunkers could also be a source, since arsenic was also found in the drainage from Site P11 and Site P13. A second drum (also removed), apparently containing an arsenic-based compound (the drum confirmation soil sample had 110 μg/g of arsenic), was also found behind Building T465 (Site P23). Therefore, drum location is approximately 400 feet south of Honey Brook. However, surficial drainage is minimal from Site P23, and arsenic was not detected at elevated levels in groundwater at the site, thus it is unlikely that a source of arsenic in Honey Brook is the drum found at Site P23.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 2-4
Chemical Summary Report For Facility Wide Surface Water Samples
Site: BK5
Units: UGL

Test	Site ID	E3-BCK-D05					
	Field Sample ID	WXBCK051					
	Sample Date	09/22/93					
Test	Parameter .						
TAL METAL	Aluminum	187 J					
	Arsenic	4.69 !@					
	Barium	6.76 J					
	Calcium	3510					
	Iron	809 J					
	Lead	1.47 J					
	Magnesium	822					
	Manganese	66.8					
	Potassium	902 J					
	Sodium	3210					
	Zinc	3.13 J					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 2-5
Chemical Summary Report For Facility Wide Sediment Samples
Site: BK5
Units: UGG

	Site ID	E3-BCK-D05					
	Field Sample ID	DXBCK051					
	Sample Date	09/22/93					
Test	Parameter .						
TAL METAL	Aluminum	1300					
	Arsenic	8.72 !#					
	Barium	8.47					
	Beryllium	0.109 J					
	Calcium	550					
	Chromium	2.28					
	Cobalt	3.46					
	Copper	1.36					
	Iron	2250					
	Lead	7.45 J!					
	Magnesium	203 J					
	Manganese	77.8 !					
	Nickel	2.68					
	Selenium	0.168 J					
	Vanadium	3.47					
	Zinc	11.7					
TCL Pest	Endosulfan Sulfate	0.006 KJC!					
	Endrin	0.119 JC#					
	Lindane	0.010 KC!#					
	P,P-DDD	0.120 C#					
	P,P-DDE	0.066 C#					
	delta-BHC	0.012 C					
	gamma-Chlordane	0.005 KJC!					
TOC	Total Organic Carbon	289000					
TPHC	Total Petroleum Hydrocarbons	15.2 J#					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Pesticides found in Honey Brook sediments are likely the result of historic pest management practices at the Annex. Both arsenic and pesticides appear to accumulate in the organic-rich sediments either in the ponded area east of Site P26 just above Puffer Pond Road or in the wetlands at the Honey Brook outlet into Taylor Brook. PAHs were found above background and screening levels in sediments at Puffer Road, probably indicating limited contamination in the area immediately adjacent to the road.

Graph 2-2 shows a profile of arsenic concentrations in sediments in Honey Brook.

2.1.2.5 Taylor Brook from Honey Brook to Drainage from P45

Two surface water samples (FW1SW1 and SW3) were taken in Taylor Brook below Honey Brook before the entry of drainage from Site P45. No contaminants were identified in either of these samples, although the method detection limits for the SW3 sample taken by Dames & Moore in 1984 were much higher than in more recent sampling. In sediment samples, arsenic (20.0 μg/g) was found in one of the samples (SED3) above background and screening levels. Several PAHs were also found at SED3, but were below screening levels. No sites are located nearby upstream from this part of Taylor Brook, and the arsenic level is probably related to upstream sources.

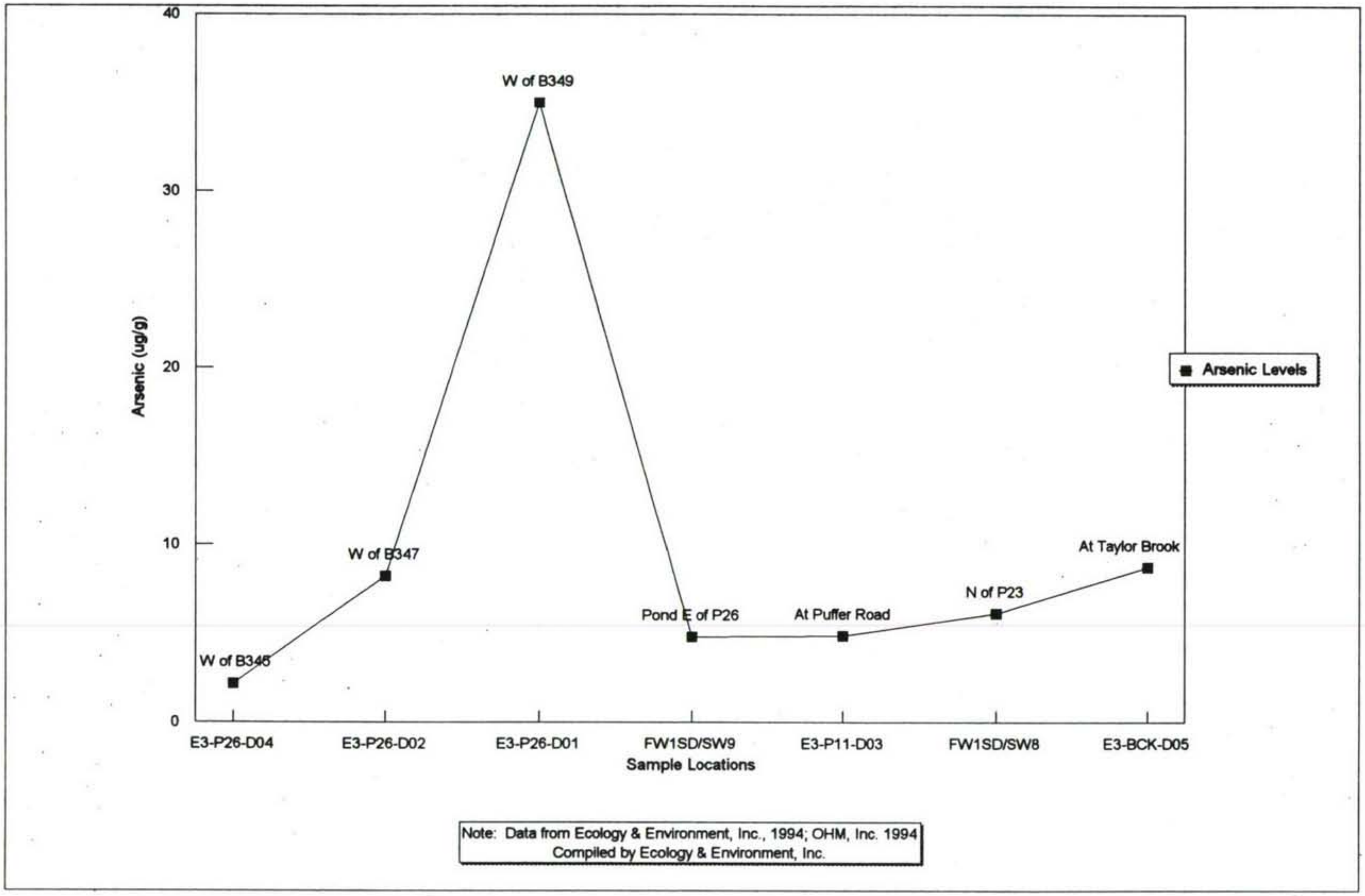
2.1.2.6 Drainage from Site P45

Surface water and sediment samples were taken downstream of the wetland and pond (at sample point E3-P45-D01) that are likely to receive surface runoff from Site P45. As noted above, a background surface water/sediment sample (E3-BCK-D08) was taken upstream of the wetland and pond. Arsenic was found in the Site P45 surface water (106 μg/L) and sediment samples (19.1 μg/g) at levels above the upstream background samples and screening levels. The arsenic found in surface water at this point was the second highest concentration found in Annex waters to date. These samples were taken at a point that is approximately 60 feet downgradient from the former location of a drum where a confirmation soil sample had indicated high concentrations (260 μg/g) in residual soil. Arsenic was not found above screening levels in soil samples at one of the burn areas in Site P45. Iron was found in the surface water sample at a level (7,180 μg/L) above background (4,810 μg/L) and the screening level of 1,000 μg/L (MA/CWA WQC for protection of aquatic life) and may be related to the metal debris observed just upstream of the surface water sample point.

2.1.2.7 Taylor Brook From Drainage from P45 to Site P42

From P45 to Patrol Road

Three surface water and sediment samples (A1SD1/SW1, A1SD2/SW2, and A1SD3/SW3) were collected in Taylor Brook downstream of the drainage from Site P45 as part of the investigation of Sites A1 and A2. No contaminants were found in surface water samples at concentrations above background and surface water screening values. In sediment sample A1SD2, which is downgradient of Site A1, arsenic (81 μg/g in the sample and 110 μg/g in the duplicate analysis), cadmium (2.57 μg/g), iron (57,000 μg/g), and nickel (17.9



Graph 2-2 Arsenic Concentrations in Sediments in Honey Brook

μg/g) were all above background and sediment screening values. The levels of these metals was significantly higher than in the sediment sample taken upstream (A1SD1) and downstream (A1SD3) of this sample point. Arsenic (11 μg/g) was also above screening levels in the sediment sample (A1SD3) taken just upstream of Patrol Road. PAHs and DDT and its degradation products DDD and DDE were also found in this sediment sample in concentrations above background and sediment screening values, probably reflecting the impact of runoff from the road or passing automobile traffic and the historic pest management practices at the Annex.

Unlike the sediment below Site A1, monitoring wells related to Site A1 did not detect arsenic, cadmium, iron, or nickel at elevated levels. In one of the monitoring wells (E3-A02-M01) at Site A2, arsenic (57.1 μg/L), iron (73,000 μg/L) and nickel (102 μg/L) were found in unfiltered groundwater samples above screening levels, but not in filtered samples. At Site A1, cadmium (up to 11.8 μg/g) was the only one of the metals found in sediments at A1SD2, that was found at a level above background in the site soil. At Site A2, arsenic (up to 44 μg/g) was the only one of the metals found in sediments at A1SD2 that was found above background levels in soil. The source of the arsenic at A1SD2 could be Site A2 through either surface runoff or groundwater discharge, but it is more likely that upstream sources have resulted in accumulation of arsenic in sediments at this point in Taylor Brook. In particular, arsenic was found in surface water upstream at Site P45. The other metals could also be related to Sites A1 or A2, but are more likely the result of metal debris in Taylor Brook.

From Patrol Road to P42

No contaminants were found in two surface water samples (FW1SW10, SW1) taken on Taylor Brook immediately downstream of Patrol Road. In two sediment samples taken at this point (FW1SD10, SED1), arsenic (30 μg/g) was the only metal found above background and screening levels. Several PAH compounds were also found in the FW1SD10 sample above screening levels, and are likely the result of passing automobile traffic or runoff from Patrol Road. DDT (0.015 μg/g) was found in one of the sediment samples above background and screening levels. Cyclonite (RDX) was found at 0.9 μg/g and was also found by Dames and Moore in the SED1 sediment sample (taken in 1984) at this point. No sediment screening value could be found for this compound. The RDX concentration is well below the soil screening level of 5.8 μg/g (MCP GW-1/S-1). RDX (up to 23.8 μg/g) was found in soil samples taken by OHM in 1992 at Site A2, a former demolition area. RDX was not found in any other surface water or sediment samples in Watershed 1B.

One surface water and one sediment sample were taken on Taylor Brook just downstream of Site P42 and slightly north of the Annex boundary. Arsenic (8.49 μg/L) was found in surface water not only above background, but also above the screening level of 0.018 μg/L (MA/CWA WQC for consumption of fish and water) and the MA/CWA WQC for consumption of fish alone (0.14 μg/L). The arsenic level at this point was well below the MA/CWA WQC for the protection of aquatic life (190 μg/L). Iron (2500 μg/L) and lead (3.99 μg/L) were also found in the surface water sample at levels above the MA/CWA WQCs

for protection of aquatic life, but were well below the highest concentration in background streams at the Annex.

In the sediment sample taken downstream of Site P42, arsenic was found (4.72 μg/g) above background but below the sediment screening value of 6 μg/g (Ontario MOE LEL). Lead (30.0 μg/g) was also found in sediments at this point above background, but below the screening level of 31 μg/g (Ontario MOE LEL). Lead (up to 250 μg/g) was found above background in two of four soil samples taken near the small amount of debris at Site P42, but was found at concentrations below the screening level of 300 μg/g (MCP GW-1/S-1). DDT (0.013 μg/g) and its breakdown products, DDD (0.013 μg/g) and DDE at (0.037 μg/g), were found in the sediment sample at levels above background and screening levels. However, none of these pesticides were above NYSDEC or EPA SQC for DDT (EPA SQC is 0.109 μg/g), DDD and DDT (NYSDEC SQC for both at 0.132 μg/g) that were adjusted for the total organic carbon (TOC) content of the sediment sample (132,000 μg/g or 13.2 percent). Given that the NYSDEC and EPA criteria are derived using a site-specific organic carbon parameter, it is likely that these criteria are more appropriate than the NOAA ERL or Ontario MOE LEL levels used for screening which are not site-specific. Low levels of several other pesticides, including lindane (up to (0.029 μg/g), DDT (up to 0.130 μg/g), DDD (up to 0.110 μg/g) and DDE (up to 0.230 μg/g) were found in several soil samples at Site P42, but at concentrations below soil screening levels.

Given the arsenic found further upstream in Taylor Brook, and the fact that arsenic was not found at elevated level in the soils at Site P42, the likely source of the arsenic in surface waters at the Site P42 sample is from further upstream. The low levels of pesticides found in sediments may be related to the pesticides found in soils, but may also indicate some accumulation of these compounds in the organic-rich sediments from upstream runoff.

2.1.2.8 Watershed Assessment Summary

As in Watershed 1A, the key concern in Watershed 1B is the presence of arsenic in nearly half of the surface water and sediment samples above both background and screening levels. Arsenic was found in drum confirmation samples taken in residual soil at the former locations of one drum at Site P4 (200 μg/g) and at Site P45 (260 μg/g), and in surface water and sediment samples taken downstream of these drums. The only other specific source of arsenic in Watershed 1B is a third drum which was removed from behind Building T465 (Site P23), where arsenic (110 μg/g) was also found in a drum confirmation sample. Other sources of the arsenic may include the bunkers located along the eastern side of Honey Brook, as arsenic has been found in soils outside bunkers west of Puffer Pond, or a possible source is that arsenic-based herbicides may have been used at some time around the building, bunkers and roads at the Annex for weed control. It is also possible that some of the arsenic levels are due to leaching of naturally occurring arsenic in Annex soils. The arsenic level (110 μg/g) found in one of the Taylor Brook samples (A1SD2) taken in the area between Site A1 and Site A2 was the highest arsenic concentration in sediments found in Annex streams, wetlands, and Puffer Pond. Arsenic was found in unfiltered groundwater samples and soils at Site A2 above screening levels potentially indicating a connection to Site A2, but the arsenic found in sediments at this samples may also indicate accumulation of arsenic from points

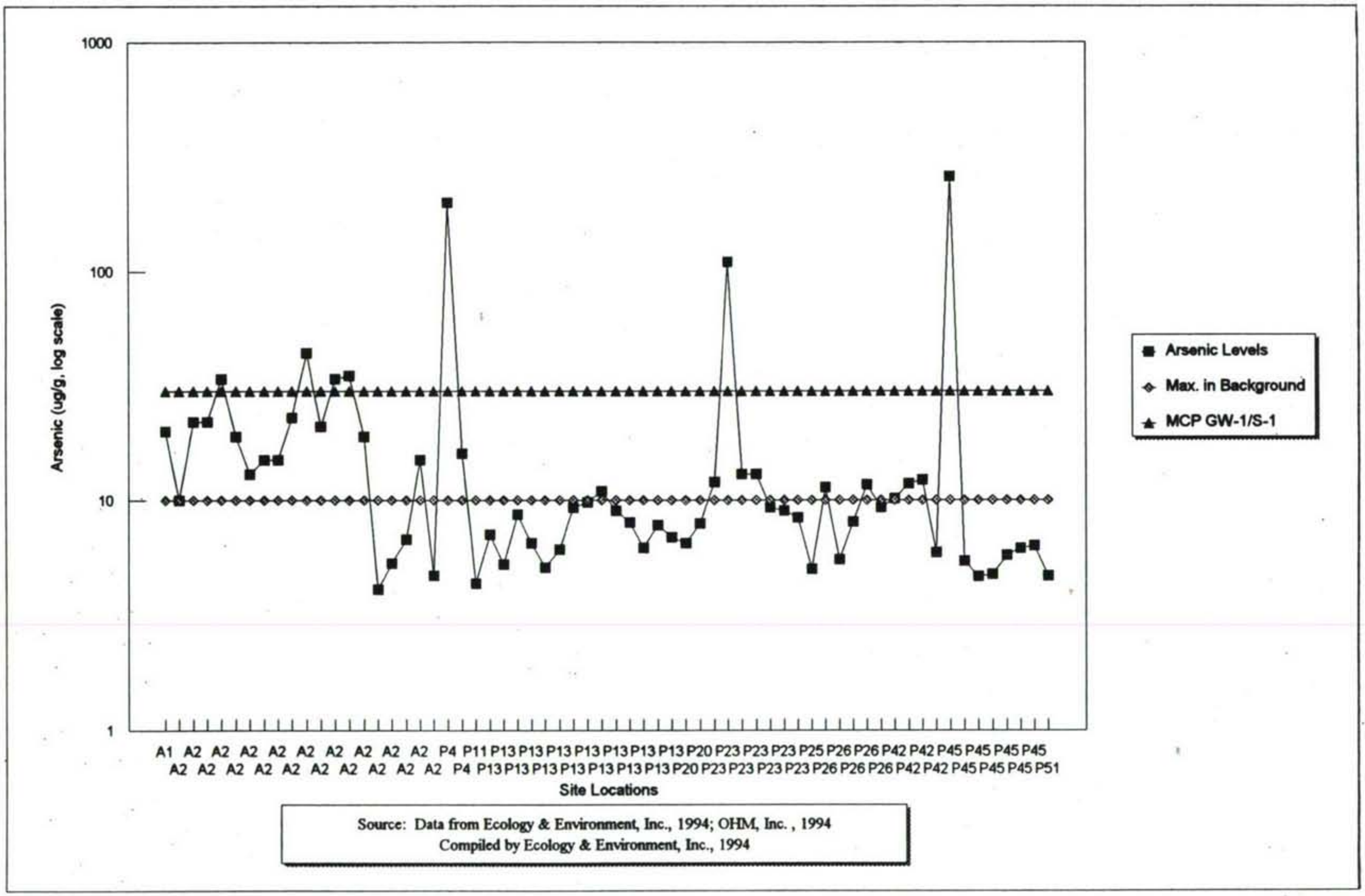
upstream, either from the drum at Site P45, from Honey Brook, or from the drainage from the central bunker area and Puffer Pond. As arsenic was found in surface waters at the Annex boundary above background and screening levels, further investigation may be needed to identify natural and anthropogenic sources of arsenic influencing Honey and Taylor Brooks.

Several other metals, including iron and lead in surface water, and cadmium, copper, iron, lead, nickel, and zinc in sediments were found at a few sample points in Taylor Brook above background and screening levels. Iron and lead above screening levels were found in the background surface water sample (E3-BCK-D08) taken in this watershed, and the concentrations of these metals probably reflect natural concentrations. Cadmium, copper, nickel, and zinc were found in sediments at several isolated points in the watershed, particularly in one sample (E3-P13-D01) in the drainage from Site P13, and in the one Taylor Brook sample (A1SD2) where the high arsenic concentration was also found. These results may indicate some metal debris or other source located nearby these specific sample points, given that these metals were not particularly elevated at points upstream of these samples.

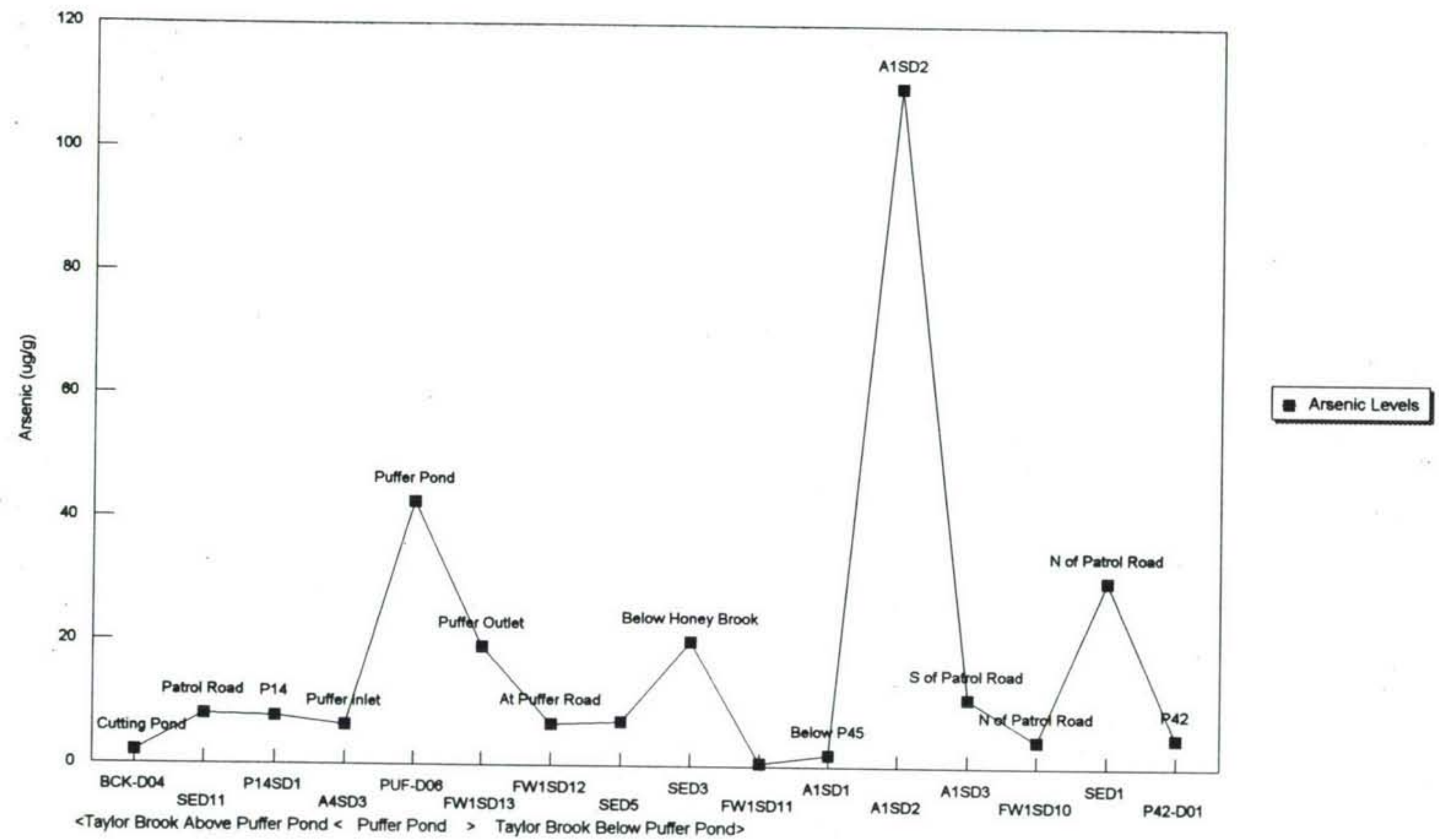
DDT and its degradation products were found above screening levels in the surface water sample taken at the southeastern drainage from Site P13, indicating some surficial runoff of these pesticides into the tributary to Taylor Brook. DDT and its degradation products were found in approximately half of the Watershed 1B sediments above screening levels, probably reflecting past pest management practices at the Annex. Concentrations of DDT, DDD, and DDE were highest at areas with organic-rich sediments.

PAHs were found in sediments in Honey Brook along Puffer Road, and in Taylor Brook, along Patrol Road, but not in any other sediment sample in Watershed 1B. These result indicate a limited impact of passing automobile traffic and road runoff on local sediments. TPHC were only found in the streams draining from Sites P11 and P13, and are probably the result of runoff of petroleum from site activities in this area, which included a gasoline station, and car fire training. The lead levels found in the drainages from Sites P11 and P13 may also reflect runoff of gasoline products containing lead.

Graph 2-3 below shows a profile of arsenic concentrations found in soil samples by site in Watershed 1B. Graph 2–4 is a profile of arsenic concentrations in the drainage from Cutting Pond (in Watershed 1A) to Taylor Brook at Site P42 outside the Annex boundary in Watershed 1B. Tables 2-6 and 2-7 provide a summary of compounds found at concentrations above background and screening levels in surface waters and sediments in Watershed 1B.



Graph 2-3 Arsenic Concentrations in Soils at Sites in Watershed 1B



Note: Data from Ecology & Environment, 1994; OHM, 1994; Dames & Moore, 1986
Compiled by Ecology & Environment, 1994

Graph 2-4 Arsenic Concentrations in Sediments in Taylor Brook

Table 2-6

COMPOUNDS FOUND ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SURFACE WATERS IN WATERSHED 1B (μg/L)

Compound	Max. Back-ground	Screen Level	Source	Highest Concen-tration	Site ID	Above Background and Screen Levels: Location Found	Above Background and Screen Levels: Frequency
Arsenic	3.15	0.018	MA/CWA WQC[1]	106	E3-P45-D01	P4, P13, Honey Brook (P26 samples), at Puffer Road, P42, P45	9/18
Iron	4810	1,000	MA/CWA WQC[2]	7180	E3-P45-D01	P13, P45	2/18
Lead	10.3	3.2	MA/CWA WQC[2]	11.1	E3-P13-D01	P13	1/18
DDD	--	0.00083	MA/CWA WQC[1]	0.018 (est.)	E3-P13-D03	P13	1/18
DDE	--	0.00059	MA/CWA WQC[1]	0.055	E3-P13-D03	P13	1/18
DDT	--	0.00059 0.001	MA/CWA WQC[1] MA/CWA WQC[2] (for aq. life)	0.263	E3-P13-D03	P13	1/18

[1]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for human consumption of water and fish.
[2]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for protection of aquatic life.

Source: Ecology and Environment, Inc. 1994.

Table 2-7

COMPOUNDS FOUND ABOVE BACKGROUND AND SCREENING LEVELS IN SEDIMENTS IN WATERSHED 1B (μg/g)

Compound	Max. Back-ground	Screen Level	Source	Highest Concen-tration	Site ID of Highest Concentration	Locations where found Above Background and Screen Level	Frequency Above Background and Screen Level
Arsenic	2.03	6	Ontario MOE LEL[1]	110	A1SD2	Taylor Brook (A1 samples), P4, P13, Honey Brook (P26 sample), P45	12/26
Cadmium	<.500	0.6	Ontario MOE LEL	2.57	A1SD2	Taylor Brook (A1 sample), P4, P13, Honey Brook (P26 sample)	4/24
Copper	6.33	16	Ontario MOE LEL	34.0	E3-P13-D01	P13	2/26
Iron	7590	20,000	Ontario MOE LEL	140,000	E3-P13-D01	Taylor Brook (A1 sample), P13	3/24
Lead	4.48	31	Ontario MOE LEL	72.2	E3-P13-D01	P11, P13	2/26
Nickel	5.92	16	Ontario MOE LEL	29.1	E3-P13-D01	Taylor Brook (A1 sample), P13	2/24
Zinc	20.8	120	Ontario MOE LEL	370	E3-P13-D03	P13	2/26
Anthracene	---	0.085	NOAA ERL[2]	0.210	E3-P11-D03	At Puffer Road	1/24
Benzo(a) anthracene	---	0.23	NOAA ERL	2	A1SD3	At Patrol Road and Puffer Road	3/24
Benzo(a) pyrene	---	0.4	NOAA ERL	5	A1SD3	At Patrol Road and Puffer Road	3/24

Footnotes at end of table.

Table 2-7 (continued)

COMPOUNDS FOUND ABOVE BACKGROUND AND SCREENING LEVELS IN SEDIMENTS IN WATERSHED 1B (μg/g)

Compound	Max. Back-ground	Screen Level	Source	Highest Concen-tration	Site ID of Highest Concentration	Locations where found Above Background and Screen Level	Frequency Above Background and Screen Level
Benzo(b) fluoranthene	---	0.7	MCP GW-1/S-3[3]	5	A1SD3	At Patrol Road and Puffer Road	3/24
Chrysene	---	0.4	NOAA ERL	5	A1SD3	At Patrol Road and Puffer Road	3/24
Fluoranthene	---	0.6	NOAA ERL	8	A1SD3	At Patrol Road and Puffer Road	3/24
Phenanthrene		0.225	NOAA ERL	5	A1SD3	At Patrol Road and Puffer Road	3/24
Pyrene		0.35	NOAA ERL	5	A1SD3	At Patrol Road and Puffer Road	3/24
DDD		0.002	NOAA ERL	0.760	E3-P13-D01	At Patrol Road (A1 sample), P13, P26, P42	13/23
DDE	---	0.002	NOAA ERL	0.540	E3-P13-D01	At Patrol Road (A1 sample), P11, P13, P26, P42	12/23
DDT	---	0.001	NOAA ERL	0.230	E3-P13-D01	At Patrol Road (A1 sample), P11, P13, Honey Brook (P26 samples), P42,	12/23
TPHC	16.6	2	Ontario MOE LEL	295	E3-P13-D02	P11, P13	3/15

[1]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[2]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range Low.
[3]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

2.1.3 QA/QC Program Analysis of Results for Watershed 1B

This section provides a summary of the results of the QA/QC review performed using the protocol described in Volume I, Section 5.3.3.

Data for Watershed 1B were evaluated for usability by reviewing laboratory and field QC sample data for contamination possibly introduced into field samples by either sampling or analysis procedures. First, method blanks were reviewed for each analyte in the 239 lots associated with Watershed 1B, followed by trip blanks and then rinsate blanks. Following consideration of laboratory and field QC blank samples data, laboratory flagging codes and USAEC data qualifiers were evaluated with laboratory control charts for each lot and sampled for quality assurance problems. Analytical results were then reviewed for precision through consideration of the RPD between each sample/duplicate pair and MS/MSD sample set.

Following is a discussion of samples for each study area affected by QA/QC evaluation. Samples with contamination also found in the blank were qualified either with a "B" usability code for "present in the blank" or a "K" usability code for a result-biased high. Samples considered to have quality assurance problems were qualified with either an "L" usability code for a result-biased low or "R" for rejected. Samples exhibiting either high or low recoveries were qualified with a "J" usability code for estimated or "R" for rejected. Appendix F provides a list of all QC summary data for method blanks, trip blanks, rinsate blanks, field duplicate samples, and MS/MSD samples.

2.1.3.1 Site A2 — Demolition Ground I

Blank contamination was found for eight analytes in 189 samples. The analytes of concern were 4-amino-2,6-dinitrotoluene, methylene chloride, and zinc from method blank contamination, and 1,3-dinitrobenzene, aluminum, iron, sodium, antimony, and zinc from rinsate blank. The metals were attributed to the standard soil matrix or the source water used to create the blanks and the organics, 4-amino-2,6-dinitrotoluene, 1,3-dinitrobenzene, and methylene chloride can be attributed to either laboratory equipment carryover, or common laboratory contamination. Methylene chloride was also found in at least one trip blank.

Additionally, potassium, manganese and antimony were biased high in some samples because they were found to be in rinsate blanks at a concentration higher than the comparison level but still at a level to which sample concentrations could be biased.

After review of precision for duplicate pairs, only one analyte (arsenic) was found to be outside of precision criteria in one sample (MXA02011). As a result, this sample was qualified as estimated.

Four compounds (silver, lead, antimony, and selenium) were found to have low MS/MSD recoveries, likely due to matrix interferences biasing the results low. As a result, six samples (SX0201-6X1) were qualified as estimated for one or more of these analytes.

2.1.3.2 Site P11 — Building T405 Area

For Samples Collected Prior to April 1994

Blank contamination was found for 16 different analytes in 194 samples. Acetone, aluminum, bis(2-ethylhexyl)phthalate, methylene chloride, endosulfan sulfate, potassium, sodium, lead, and zinc were each detected in at least one method blank. Zinc, sodium, aluminum and lead were contaminants due to the source water used to prepare the standard matrix while acetone, methylene chloride, and bis(2-ethylhexyl)phthalate are considered common laboratory contaminants. Endosulfan sulfate can be attributed to carryover from laboratory equipment. Aluminum, cadmium, methylene chloride, iron, heptachlor, lindane, manganese, sodium, antimony, TPHC, and zinc were found in the rinsate blanks and are attributable to either the source water or to particulates from the sampling equipment entrained with the rinsate source water put into the sample containers. The only volatile organic found in the trip blanks was methylene chloride, which was attributed to laboratory contamination.

Analytes for which some samples were biased high were potassium, magnesium, manganese, sodium, lead, and zinc because these analytes were found at concentrations which were greater than five times the concentration found in either the rinsate or method blank, but less than ten times the rinsate or method blank level.

Analytes which were found to exceed RPD precision criteria for duplicate samples included aluminum, arsenic, barium, and iron. As a result, associated samples were qualified as estimated.

There were no analytes for which samples were qualified based on MS/MSD precision problems.

For Samples Collected in April 1994

Sample results for the surface water and sediment samples collected at E3-P11-D04 on April 26, 1994 were qualified based on method blanks and control spike results. In sample WXP11043, results for barium, beryllium, copper, lead, and vanadium were qualified as estimated values as the concentrations of these compounds were above the MDL but below the RMDL. In sample DXP11043, results for antimony, beryllium, chromium, magnesium, and vanadium were qualified as estimated because the concentrations of these compounds were above the MDL but below the RMDL. The result for selenium was qualified as biased low because the standard matrix spike results were considerably below the control limits established at the laboratory.

2.1.3.3 Site P13 — Massachusetts Fire Fighting Academy

Blank contamination was found for 12 different analytes in 195 samples. Analytes which were found in the method blanks included acetone, aluminum, methylene chloride, potassium, sodium, lead, and zinc. The presence of the metals can be attributed to the

standard matrix or the source water used to create the blanks and methylene chloride and acetone can be considered common laboratory contamination. Aluminum, beryllium, cadmium, iron, antimony, TPHC, and zinc were detected in the rinsate blanks and were due to particulates entrained with the rinsate source water from the sampling equipment or, from the source water. TPHC, which is considered an isolated case, is possibly due to residue on laboratory glassware. In all cases, the samples were qualified accordingly. Methylene chloride and acetone were the only analytes detected in the trip blanks and are common laboratory contaminants.

Other analytes were found in the method blanks but only at levels high enough to bias five samples (MX1301X1, MX1302X1, MXP13012, WX1301X1, WXP13052). Aluminum, heptachlor, potassium, sodium, and zinc were the analytes. Cadmium, potassium, magnesium, aluminum, iron, sodium, manganese, and zinc were found in rinsate blanks at levels great enough to bias 15 samples high for one or more of these analytes.

After review of duplicate RPD precision criteria, only seven samples for four analytes (aluminum, arsenic, barium, and iron) were estimated because of the results from duplicate samples.

There were no instances for which samples needed to be qualified based on MS/MSD recoveries.

2.1.3.4 Site P23 — Building T465 Drums

Blank contamination was found for 18 analytes in 7 samples. Compounds which were found to affect samples due to their presence in method blanks were: α-endosulfan, bis(2-ethylhexyl)phthalate, beryllium, methylene chloride, dieldrin, endosulfan sulfate, potassium, sodium, and zinc. Pesticides were most likely due to carryover from the gas chromatography (GC) column, and methylene chloride and bis(2-ethylhexyl)phthalate are common laboratory contaminants. Metals were most likely from the standard matrix or source water used to make the blanks. Nine samples were affected by rinsate blanks for one or more of the following: acetone, aluminum, cadmium, carbon disulfide, iron, heptachlor, sodium, DDT, antimony, TPHC, and zinc. Aluminum, cadmium, and antimony were attributed to particulates entrained with the rinsate source water from the sampling equipment, or from the source water, while the remainder of the analytes were attributable to laboratory contamination or equipment carryover. Methylene chloride was the only analyte found in the trip blank and is a common laboratory contaminant.

Only three samples (MFP23011, MXP23012, and SXP23031) were biased high for endosulfan sulfate, sodium, lead, and DDE which were found in the method blank. Antimony and zinc were biased high in only two samples (MXP23011 and SXP23021) due to their presence in rinsate blanks.

Arsenic, dieldrin, endrin, endrin aldehyde, DDD, and DDT were all found to exceed RPD precision criteria after review of duplicate data. As a result, three samples (MXP23011, SDP23011, SXP23011) were estimated as a result of findings from the duplicate samples.

There were no MS/MSD QA/QC issues to note for Site P23.

2.1.3.5 Site P26 — Taylor Drop Zone

Blank contamination was found for 26 analytes in 47 samples. Analytes found in the method blanks were α–BHC, acetone, α-endosulfan, aluminum, bis(2-ethylhexyl)phthalate, beryllium, methylene chloride, carbon disulfide, delta-BHC, endrin aldehyde, endosulfan sulfate, heptachlor, heptachlor epoxide, potassium, lindane, sodium, DDD, DDE, and zinc. Analysis of rinsate blank results indicated the presence of acetone, aluminum, carbon disulfide, potassium, zinc, sodium, cadmium, iron, manganese, lead, antimony, and TPHC. Analytes found in trip blanks included 1,1,1-trichloroethene, acetone, methylene chloride and carbon disulfide. In all cases, the presence of metals is attributable to either particulates entrained with the rinsate source water from the sampling equipment, or to the source water. The remainder of analytes are attributable to laboratory contamination, including GC column carryover of contaminants. TPHC, in particular, may be due to residue on laboratory glass-ware.

Alpha-endosulfan, arsenic, endrin aldehyde, iron, sodium, DDD, antimony, and zinc were biased high in thirty-four samples due to the concentrations of analytes found in either the method blanks or rinsate blanks.

The only instances for which data was biased low due to low recoveries were for antimony in lot ABAQ, and selenium in lot ABAR. These instances affected fourteen samples.

Only aluminum and arsenic were estimated in some samples due to imprecision in the RPD value for duplicate sample results, and there were no cases for which MS/MSD recoveries caused qualification of data.

2.1.3.6 Site P42 — Off-Site Dump

Six analytes were found in blank samples associated with Site P42. Those found in the method blanks included methylene chloride, sodium and zinc, while cadmium, methylene chloride, di-N-butyl phthalate, and potassium were found in the rinsate blanks. The only analyte found in trip blank samples was methylene chloride. In total, seven samples contained analytes which were qualified as found in the blank. In all cases, cadmium was attributable to particulates entrained in the rinsate water and the remaining metals were attributable to the source water used for rinsates or the standard matrix water. Methylene chloride and di-N-butyl phthalate are considered common laboratory contaminants. In addition, potassium was biased high in four surface soil samples because the concentration found in the sample was greater than the comparison level from the concentration found in the rinsate blank sample.

Aluminum in only one sample (WX4201X1) was the only case for which data were qualified as estimated due to exceedances of duplicate precision criteria. There were no such cases for MS/MSD samples.

2.1.3.7 Site P45 — Burned Area Outside Fence

A total of sixteen samples was affected by method blank contamination for the following analytes: α–endosulfan, aldrin, C36, methylene chloride, dieldrin, endrin, endosulfan sulfate, lindane, and DDE. Only sodium and antimony, found in rinsate blanks associated with Site P45, affected three samples. The pesticides found in the method blanks can be attributed to laboratory equipment carryover, while methylene chloride, the only compound which was also found in trip blank samples, was attributable to common laboratory contamination. C36 is a tentatively identified compound (TIC) and should not be considered as a possible contaminant. The metals found in the rinsate blank samples are attributable to the source water used for the rinsate blanks.

Analytes for which field sample data was biased high included α-endosulfan, endrin, endosulfan sulfate, and potassium.

A review of the duplicate sample data for Watershed 1B indicated that aluminum, beta-endosulfan, DDD, and DDT exceeded RPD precision criteria. As a result, three samples for one or more of these analytes were qualified as estimated.

Only selenium for sample WXP45011 was qualified as estimated due to low matrix spike recoveries.

2.2 SITE DESCRIPTIONS

2.2.1 Site A1 — Decontaminated Mustard Area

During an interview (Interview undated) with a Natick Laboratory employee as part of the USATHAMA Assessment in 1980, this site was identified as an area that might have been used to bury one to two dozen plastic bags containing clothing that was decontaminated after use in permeability tests involving mustard agent. Physical site characteristics are presented in Figure 2-2.

2.2.1.1 Site Location

Site A1 is situated in the northern part of the Annex and is accessed by a dirt road that diverges southwest from Patrol Road. The dirt road continues southwest for about 150 feet and terminates in a circular clearing. The entire area is surrounded by small trees, bushes, and thickets. At the entrance to the clearing, on the western side of Site A1, a rusted and crushed drum lies half buried in the ground. Within the forest, on the southern side of the clearing, is an area with dispersed household debris including chairs, tables, cans, tires, and pieces of foam. A 3-foot wide and 1-foot deep ditch runs southwest to northeast from a little swamp south of Site A1 to a larger debris-scattered area in the eastern side of the site. The debris here includes jerry cans, gasoline cans, bottles, metal piping, pots, and a small metal cage. The clearing itself is bare with patches of grass and scattered metal debris.

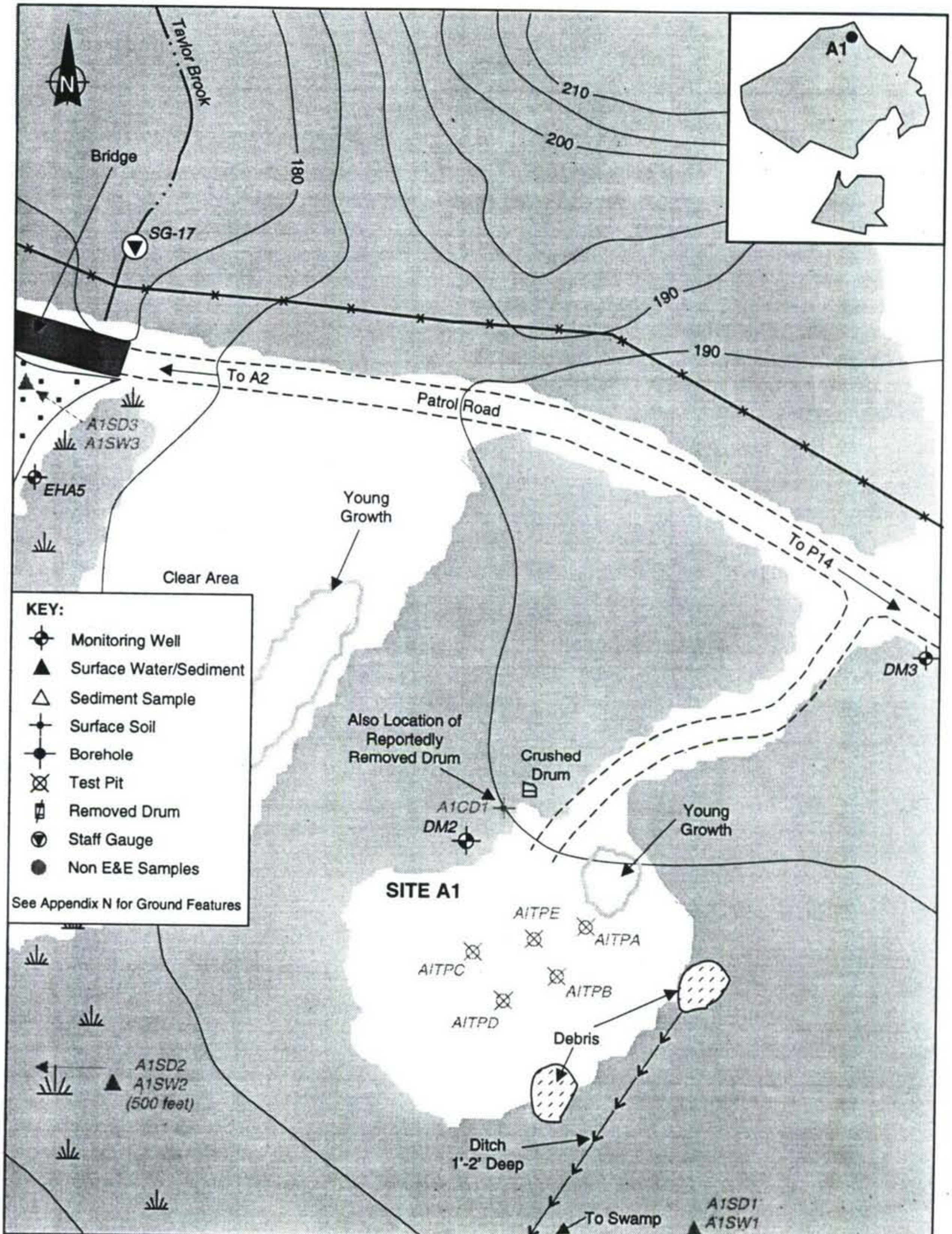
2.2.1.2 Physical Characteristics

Site A1 is located on a kame terrace, flanked by a ground moraine (hill of glacial till) to the north and wetlands to the southeast and west. The surface elevation at Site A1 is approximately 188 feet AMSL. Average groundwater elevation at the site is 185 feet AMSL.

Geotechnical information collected from one on-site monitoring well (DM2) and two other wells in the vicinity (DM3 and EHA–5) show a well-sorted sand, silt, and gravel layer typical of kame terrace. This strata extends to a depth of at least of 23 feet BGS, the maximum depth achieved at any of the three monitoring well locations. Bedrock was not encountered during any of the subsurface explorations, but the underlying formation is presumed to be Gospel Hill Gneiss (Hansen 1956). This area was investigated by the Town of Maynard (Dufresne-Henry 1982), and found to be underlain at shallow depths ($\approx$20 feet) by silty clayey, low transmissivity lacustrine deposits.

In 1992, OHM calculated an average transmissivity of 20 feet^2 per day for wells DM2 and DM3, using an assumed aquifer thickness of 15 feet. This low transmissivity is indicative of the dense material in which each well was installed; however, a conservative aquifer thickness estimate may cause the transmissivity to appear lower than actual.

11: SUDBURY\UC6_A1.CDR



SOURCE: OHM Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

**Figure 2-2 MAP OF SITE A1
DECONTAMINATED MUSTARD AREA**

Surface water flows west and southwest from Site A1 into an adjacent wetland and ultimately into Taylor Brook. Based on hydrogeologic data and water levels collected at wells DM2, DM3, and EHA-5, groundwater flows west toward the wetland and Taylor Brook.

2.2.1.3 Ecological Characterization

This site consists of a 200 foot by 300 foot clearing vegetated with a mixture of grasses, forbs, shrubs, and young growth trees. A forest of densely growing red maple and ash trees ranging from 40 to 60 feet in height surrounds the clearing (LFS 1983).

Based on the topography of the area, surface water runoff from the site will flow west towards Taylor Brook. Groundwater flow is also to the west (E & E 1993). Approximately 400 feet west of the site, on both sides of Taylor Brook, there is a large seasonally saturated, scrub/shrub emergent wetland vegetated with saplings, shrubs and several species of aquatic plants including cattails and bulrushes (USDOI 1977).

This area provides four distinct habitats: upland forest, open area, scrub/shrub emergent wetland, and open water. The upland forest in the area is dominated by ash and maple trees. Used primarily by birds for their seeds, ash trees are only of moderate importance to wildlife. Maple trees, on the other hand, are relatively significant to wildlife. Seeds, buds, twigs, flowers, and foliage are used by upland gamebirds, songbirds, small mammals, and deer. The prairie warbler nests in the red maple, these trees are found at this site (Martin *et al.* 1951). Open areas vegetated with grasses, forbs, and shrubs are habitat for deer, ground nesting birds and small mammals such as mice, and raptors. Scrub/shrub emergent wetlands combine nutrients, the presence of diverse woody species, and the availability of water. Consequently, such areas attract an array of aquatic species, upland species, as well as species specifically adapted to wetlands. Finally, long edge habitats associated with streams and rivers provide access to drinking water, protected sites for dens and nests, for plant growth, and travel routes for many species. Fish, crustaceans, insects, plants, reptiles, amphibians, birds, and many upland species can be observed in this habitat type.

No unique habitats have been identified in the general vicinity of Site A1 (NHESP 1992). However, a population of northern starwort (*Stellaria calicantha*), a state watch-list species, was observed growing at the base of a wooded seep near Taylor Brook approximately 300 feet north of the site (Hunt 1991). Since this species is located in an area hydrologically connected to the site, it may be affected by Site A1.

2.2.1.4 Site History

An interview with a Natick Laboratory employee suggested that one or two dozen trash bags containing clothing decontaminated after use in permeability testing involving mustard agent were buried at Site A1 (Interview undated, USATHAMA 1980). From 1965 to 1972, Natick Laboratories received 100 cubic centimeters of mustard agent from Edgewood Arsenal, Maryland, for use in experiments to test the absorptive property of clothing. To conduct these experiments a Dawson apparatus was charged with 10 cubic centimeters of

mustard agent for use in the tests. This amount was estimated to be sufficient for six months of testing. An interview with a Natick Laboratory employee indicated that used clothing was routinely decontaminated with applications of bleach, reported to be the standard decontamination procedure for mustard agent. When testing was completed in 1972, it is reported that around 10 cubic centimeters of mustard agent along with the testing equipment was returned to Edgewood Arsenal, suggesting that a total of 90 cubic centimeters was used in test activities between 1965 and 1972 (USATHAMA 1980).

The decontaminated clothing was disposed of in three ways: by burial in plastic bags at the Annex, by incineration, or by sea dumping. The burial method reportedly accounted for approximately 50 percent (or 45 cubic centimeters) of the mustard agent used in clothing tests. Assuming that the bleach decontamination procedures were 99 percent effective, then only 0.45 cubic centimeters of mustard agent would remain prior to disposal.

$$(45 \text{ cm}^2 \text{ x } 0.99 = 0.45 \text{ cm}^3)$$

If this amount of mustard agent were to leach out of the disposal bags, probably less than 0.01 ounces would infiltrate subsurface soils. This amount of mustard agent, even in the unlikely event it is concentrated in one location would not pose a concern at the site. Natick personnel identified that burial at the Annex may have involved a total of not more than one to two dozen plastic bags of decontaminated clothing (USATHAMA 1980).

Natick records report that only two percent of the decontaminated clothing and related wastes were disposed of by incineration, as this practice was abandoned due to excessive smoke. Reportedly some, and presumably the remainder (accounting for 48 percent or around 43 cubic centimeters of mustard agent) of the contaminated clothing was disposed of by sea dumping, but no details are available to confirm either the amount or locations.

A review of facility maps and building records indicates that Buildings T416 (a barn) and T418 (a dwelling) existed on Site A1 at the time of Army assumption, but were demolished sometime in the early 1960s. On a 1967 facility map, a road that leads into the area is visible.

In an interview with a Natick Laboratory employee (Interview 1990b), there was also mention of possible burial of acetone near Site A1. No further information on the acetone was identified.

2.2.1.5 Results of Previous Investigations

In 1983, AEHA installed a groundwater monitoring well (EHA5) and subsequently sampled it for all constituents of the Primary Drinking Water Standard List. All compounds were below detectable levels.

In 1986, as part of the Dames and Moore investigation, groundwater samples from three monitoring wells (EHA5, DM2, and DM3) were analyzed for possible contamination by any residual contaminants on the decontaminated clothing said to have been buried on site.

Thiodiglycol, a mustard agent degradation product, was not detected in any of the samples. However, manganese (70 μg/L), chromium^{+6} (10 μg/L), and an unknown VOC (400 μg/L) were detected in the sample from well DM3.

Results of the Phase I SI conducted by OHM at A1 are described in detail in Section 7.1.5 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). Five test pits, three sets of surface water and sediment samples, a drum confirmatory sample (taken from the former location of the drum removed from the central part of the site), and groundwater samples from the three monitoring wells were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticide/PCBs, TAL metals, explosives, and thiodiglycol.

The test pit samples were found to contain metals at background levels. Pit excavations did not uncover any evidence to confirm the burial of decontaminated clothing. Soil taken at the drum location contained several metals including arsenic, barium, cadmium, calcium, copper, iron, manganese, mercury, selenium, and zinc at levels above background. The drum confirmation sample (A1CD1) also contained several PAHs and lead (650 μg/g). No thiodiglycol was detected in either surface water or sediment samples taken in the vicinity of Site A1.

Pesticides and PAHs were found in sediment sample A1SD3 and arsenic in sediment sample A1SD2. These compounds found in the sediment were either not found at Site A1 or found at far lower concentrations, thus indicating a possibility that the sediment results reflect conditions in Taylor Brook unrelated to Site A1.

Groundwater samples from the three monitoring wells did not show any unusual results except for the presence of trace carbon disulfide (2.7 μg/L) in the field duplicate from well DM3 in the June 1992 well sampling round. Wells DM2 (June 1992) and EHA5 (October 1992) also showed elevated aluminum, which could be from suspended sediment. Well EHA5 showed very elevated manganese (1.7 mg/L) in the October 1992 round of sampling. All other positive detections of the compounds tested for in groundwater are likely attributable to normal seasonal or regional variations.

2.2.1.6 Field Work Performed

No sampling was proposed for Site A1. Although, file research was undertaken to see whether disposal of the decontaminated clothing could be better tracked, the results of this search do not justify further field activities for the site. A ground penetrating radar (GPR) investigation was conducted around the area already investigated to identify anomalies that could indicate disposal pits. No digging, excavating, or subsurface sampling was planned or undertaken.

Analytical Parameters

Due to the fact that no intrusive field investigations were performed, no samples were collected for geotechnical or chemical analyses.

Geophysical Investigations

A follow-up GPR survey was performed at Site A1 to cover the area more completely and search for any buried debris. This extensive survey, fully discussed with results in Appendix E, also investigated several anomalies found during a previous GPR survey conducted by OHM. E & E completed ten GPR study lines across the site to bring the total number of survey lines to fifteen. A backfilled, trench-like structure was found to be running in a northwest-southeast direction in the southern portion of the clearing. The structure was located in an area previously investigated by OHM and was identified as one of their past test pit excavations. No other subsurface anomalies were encountered.

2.2.1.7 Nature and Extent of Contamination

No field sampling was conducted by E & E at this site, therefore, there are no new sampling results to report. The follow-up GPR survey did not detect any subsurface anomalies other than a previous test pit excavation that had been conducted by OHM in 1992.

Sampling results from the OHM investigation were screened using the preliminary screening values developed for this SI report. While OHM screened these results in a previous SI/RI report for the Annex, the results were screened again to evaluate sites for this SI report. The results of this screening are noted in the following paragraphs.

Analysis of the OHM filtered samples from the three wells (DM2, DM3, and EHA5) did not indicate any clear evidence of groundwater contamination at Site A1. The only exceedances of groundwater screening values were aluminum (350 μg/L), iron (778 μg/L), and manganese (1,700 μg/L) in samples from well EHA5. These concentrations were above the Massachusetts SMCLs for aluminum (50 μg/L), iron (300 μg/L) and manganese (50 μg/L). The aluminum level (223 μg/L) detected in a sample from well DM2, located directly downgradient of Site A1, was also above the Massachusetts SMCL.

Analysis of soil samples taken by OHM from test pit excavation indicated cadmium, cobalt, lead, manganese, nickel, and potassium at concentrations above background levels, but all maximum detections were well below soil screening values. Toluene (8 μg/g) was also detected in test pit A1TPE, but well below the soil screening value of 90 μg/g.

Analysis of the drum confirmation sample taken from Site A1 by OHM, at the location of a drum that was reportedly removed, indicated concentrations of lead (650 μg/g) and manganese (770 μg/g) above background and soil screening values for lead (MCP GW-1/S-1 soil value of 300 μg/g, MCP GW-3/S-3 soil value of 600 μg/g, and the EPA interim soil cleanup level for Superfund sites of 500 μg/g) and for manganese (MCP GW-1/S-1 soil value of 390 μg/g). Several PAHs were also detected in this sample, but only phenanthrene (0.71 μg/g) was slightly above the soil screening value of 0.7 μg/g (MCP GW-1/S-1 and MCP GW-3/S-3 soil value).

No contaminants were detected in surface water samples taken by OHM at levels above surface water screening values.

PAHs in OHM sediment sample A1SD3 were in concentrations above sediment screening values, as were DDT and its degradation products DDD and DDE. These results are probably due to the location of this sediment sample adjacent to Patrol Road, and to general pesticide spraying levels at the Annex. In sediment sample A1SD2, which is downgradient of Site A1, arsenic (81 μg/g in the sample and 110 μg/g in the duplicate analysis), cadmium (2.57 μg/g), iron (57,000 μg/g), and nickel (17.9 μg/g) were all elevated above background and sediment screening values. The arsenic level were significantly above the highest detection in background soils (17 μg/g maximum) or background stream sediments (2.03 μg/g). The levels of these metals was significantly higher than in the sediment sample taken upstream (A1SD1) and downstream (A1SD3) of this sample point.

2.2.1.8 Conclusions and Recommendations

Further geophysical investigations by E & E at Site A1 did not detect any evidence of burial locations or buried debris that might indicate the decontaminated clothing burial site. Previous sampling by OHM did not detect thiodyglycol or any other evidence of mustard agent at the site in groundwater, soil, or in surface water or sediment downgradient from the site. The buried clothing at this site has not been found, and there appears to be no detrimental impact on groundwater, soil, or surface water and sediments from burial of decontaminated clothing used in permeability testing with mustard agent.

Two concerns remain at this site. First, some limited lead, manganese, and PAH soil contamination exists in the location of a drum on the northwest edge of the site. This drum was reportedly removed in 1992, but a crushed, rusted drum was found during the field reconnaissance in September, 1993 in approximately same location as earlier identified in an OHM map. It is recommended that further action be taken regarding this drum and associated contamination. A removal of the drum and associated soil around the drum should be considered.

The second concern at this site is the elevated arsenic, cadmium, and nickel concentrations found in the sediment sample (A1SD2) taken in relation to the site. Given soil and groundwater sampling results at the site, it is unlikely that the elevated metals found in this sediment sample are related to Site A1. Thus, further investigation of these sediment results should be part of the watershed-wide assessment of Taylor Brook. Surface water and sediment samples should be taken upstream of this sample point to attempt to identify the source of the elevated metals levels.

2.2.2 Site A2 — Demolition Ground I

Site A2 was identified as a result of an environmental assessment undertaken by the Natick Laboratories in 1980. Figure 2-3 provides a site map.

2.2.2.1 Site Location

This site is located in the northern part of the Annex, southwest of the intersection of Patrol Road and Taylor Brook. There are visible signs of activity at the site. The dirt road that leads into the area divides into two roads, which rejoin about 800 feet further south. The tree line closely follows the sides of these roads. On the southern end of the patch of land created between the roads is a 10 foot by 10 foot concrete pad. This structure is bordered on either side by two semicircular berms. In the southwestern end of the site is a small clearing where a drum stood prior to removal. To the north of this clearing is a larger, cleared pit area in which sandbags were found. North of the pit area, there are two small depressions from where old drums have been removed. On the northeastern corner of the site is a soil-covered concrete building, which appears to have been the control bunker, and a telephone pole with an old switchboard box and scattered cable. An exposed iron pipe is south of well EHA4, next to the dirt road. A 25-foot tall steel observation tower is immediately to the south of the well.

2.2.2.2 Physical Characteristics

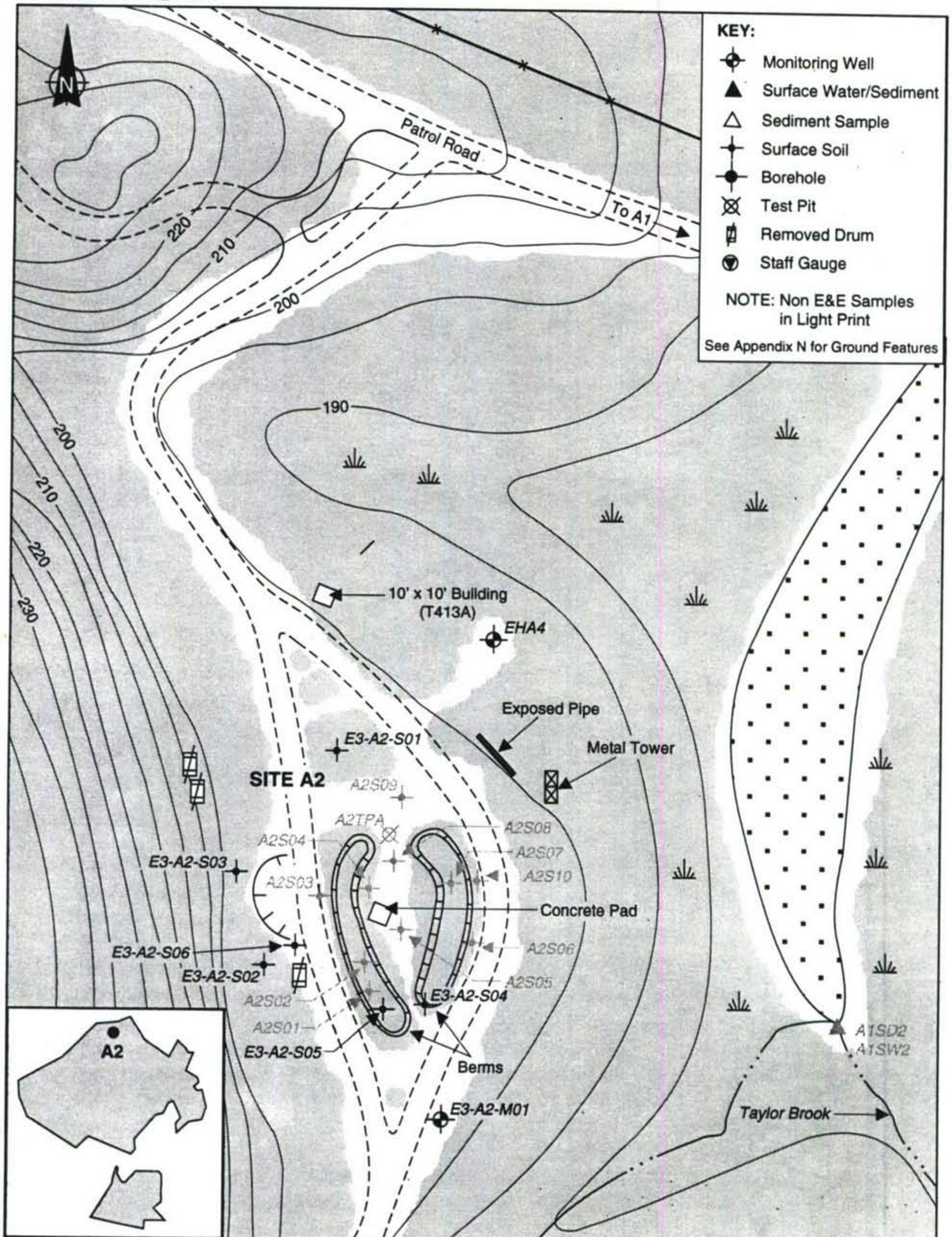
Site A2 lies in an area of glacial outwash sand and gravel on the east side of a drumlin or glacially formed hill. The surface elevation at Site A2 is approximately 195 feet AMSL. Groundwater elevation is approximately 185 feet AMSL.

Geotechnical information collected during the installation of two monitoring wells (E3–A02–M01 and EHA–4) indicate that glacial outwash, consisting of a poorly sorted silt, sand, and gravel mixture extends to a depth of 21 feet, the maximum depth achieved at either location. At monitoring well EHA–4, cobbles were encountered near the bottom of the boring and refusal was reached at 21 feet BGS. This suggests that an approximate 20-foot-thick outwash layer is underlain by tight glacial till. Two samples were collected from the boring at E3-A02-M01 and submitted for grain size and Atterberg limits analyses. Soil from the 0 to 2 foot interval was identified as non-plastic silty sand while soil from the 9 to 11 foot interval was classified as non-plastic poorly graded sand. Please refer to Appendix D for a complete summary of geotechnical results. Bedrock was not encountered during subsurface explorations, but is presumed to be Gospel Hill Gneiss (Hansen 1956).

In 1993, a transmissivity of 314.63 feet^2/day was calculated from slug test data collected at well E3–A02–M01. An aquifer thickness equal to the length the water column in the well, was used to determine this number. The transmissivity was calculated as follows:

$$T = Kb$$
$$T = (47.03)\ (6.69)$$
$$T = 314.63 \text{ feet}^2 \text{ per day}$$

11: M:\SUDBURY\UC6_A2.CDR



SOURCE: OHM Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 2-3 MAP OF SITE A2
DEMOLITION GROUND I

where

T = Transmissivity (feet^2 per day)
K = Hydraulic conductivity (feet per day)
b = Aquifer thickness (feet)

Appendix G contains complete slug test data and interpretation. This low transmissivity (less than 1,350 feet^2 per day) is comparable to other wells installed in outwash throughout the facility; however, the conservative aquifer thickness estimate may cause the transmissivity to appear slightly lower than it is. In 1981, the Town of Maynard had a study performed of this area (Dufresne-Henry 1982), which concluded that the lower valley of Taylor Brook was filled with low transmissivity glacial lake sediments at depths greater than 20 feet from surface.

Surface water at the site flows east to Taylor Brook. Based on hydrogeologic data, water levels collected at well E3-A02-M01 and EHA-4, and area drainage, groundwater also flows east to Taylor Brook.

2.2.2.3 Ecological Characterization

Most of the site, except for the dirt roads, is vegetated with red maple and ash trees ranging from 40 to 60 feet in height (LFS 1983).

Approximately 400 feet east of the site, on both sides of Taylor Brook, there is a large, seasonally saturated and scrub/shrub emergent wetland (USDOI 1977) vegetated with a mixture of saplings, shrubs and several species of aquatic plants including cattails and bulrushes.

This area provides three different habitats: upland forest, scrub/shrub emergent wetland, and open water. The upland forest in this area is dominated by ash and maple trees. Used primarily by birds for their seeds, ash trees are only of moderate importance to wildlife. Maple trees, however, are relatively significant to wildlife. Seeds, twigs, buds, flowers, and foliage from Maples are used by upland gamebirds, songbirds, small mammals, and deer. In addition, red maples such as the ones found at this site are a nesting site of the prairie warbler (Martin *et al.* 1951). Scrub/shrub emergent wetlands combine nutrients, diverse woody species, and water to attract an array of aquatic species, upland species, as well as species specifically adapted to wetlands. Taylor Brook provides drinking water, protected sites for dens and nests, sunny areas for berry producing bushes to grow, and travel routes for many species. Fish, crustaceans, insects, plants, reptiles, amphibians, birds, and many upland species can be observed in this habitat type.

A population of northern starwort (*Stellaria calicantha*), a state watch-list species, was observed at the base of a wooded seep near Taylor Brook approximately 400 feet northeast of the site (Hunt 1991). No unique habitats have been identified in the general vicinity of the site (NHESP 1992).

2.2.2.4 Site History

Site A2 had been used at various times for demolition of reject ammunition and for ordnance testing. The 1980 assessment (USATHAMA 1980) identified the area as having been used between 1942 and 1955 for the destruction of reject ammunition, mortars and rockets. However, facility maps from 1942 and 1944 do not indicate the existence of roads or structures at Site A2. A 1952 photograph notes that the area is cleared and has a road running through the site. Building T413, a reinforced concrete bunker, was built in 1952 at A2. A 1955 map does indicate the use of the area as "Demo #1", and shows the presence of two semicircular structures, likely to be the earthen berms that surround the concrete pad, still in evidence at A2. The 1955 map also identifies Building T413 and an unnamed building (later designated as Building T413A). An undated map, probably from the 1952 to 1957 period, identified the area as "T.A. #1" (Test Area No. 1) "Explosives 1 lb. Limit" (USATHAMA 1980).

A 1959 memo from the Quartermaster Research and Engineering command notes that Building T413 ("Instrument House") and Building T413A ("Personnel Bunker") were assigned to Watertown Arsenal. These assignments remained the same until at least 1964. In 1966, the designation for Building T413 was changed to "General Storehouse." A 1967 map noted that the area on the eastern part of the Annex, including Site A2, was assigned to Natick Laboratory's "Environmental Medicine" Division.

In late 1969, the Air Force Cambridge Research Laboratory (AFCRL) requested the use of Demolition Area 1 and Building T413 as a "safe" area to test explosive-activated, rocket nose cone ejection devices on a continuing basis and to maintain a small storage area for explosives. The request was for the 13 acres surrounding Site A2. The tests were planned to be conducted on the ground using a 2-foot strip of RDX (25 grams per foot) which was fixed against a aluminum nose cone and exploded. Testing reportedly would not include rocket launching. AFCRL anticipated several shots per day. Natick granted a 5-year lease to AFCRL, beginning in February 1970. It is unknown if Site A2 was used for this purpose for the full length of the lease.

Records from 1973 indicated that Building T413A was still being used as a personnel bunker, while Building T413 was being used for general storage. The 1978 Natick Environmental Assessment noted that Building T413A was then being used for equipment storage.

2.2.2.5 Results of Previous Investigations

Investigations at Site A2 have included an area reconnaissance, a geophysical study, test pit excavations with subsurface soil sampling, groundwater sampling, removal of three empty drums, and drum confirmation and surface soil sampling.

In 1983, AEHA conducted a hydrogeological assessment of Site A2. Results indicated the presence of chromium (0.01 mg/L) and nitrogen as nitrate or nitrite (0.19 μg/L) in water sampled from well EHA4. Further investigation by Dames and Moore included

analysis of a second sample from well EHA4 and of two soil samples taken near the concrete pad in the center of Site A2. In the soil samples, a maximum concentration of lead (60 μg/g), maximum concentrations of total phosphates (400 μg/g), and the explosive RDX (2 μg/g) were detected. These chemicals were not detected in the groundwater sample from well EHA4.

Results of the Phase I SI conducted by OHM at A2 are described in detail in Section 7.2.5 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). In 1992, 10 soil samples were taken around the soil berm, and one near the control building. Confirmation samples were also taken from areas where drums had been removed (see Removal section below). A test pit was also excavated to the north of the concrete pad. Light-bluish crystalline solids were encountered, and further excavation revealed rusted metal assemblies, several charred containers made from fiberglass or asbestos, blasting wires, and many magnets. Debris in Test Pit A2TPA was tentatively identified by Fort Devens Explosive Ordnance Disposal (EOD) personnel as remnants of British Land Limpet Mines.

Various metals were detected in surface soil samples at concentrations exceeding the 95 percent upper control limits (UCL) used by OHM for contaminant screening relative to background soil conditions. The following metals were found in exceedances of the 95 percent UCL: arsenic, barium, cadmium, cobalt, copper, lead, potassium, and zinc. Antimony (10 μg/g) was detected in sample A2S03. Highest concentrations of several metals, including arsenic and cadmium, were found in sample A2S08. A2S08 also contained the explosive HMX (170 μg/g). Low levels of DDT (up to a maximum of 0.165 μg/g) was found in nearly all surface soil samples. Dieldrin (up to 0.026 μg/g) was found in samples A2S07 and A2S08. One PCB, Aroclor 1254 (0.353 μg/g) was detected in sample A2S08. Camphor (245 μg/g) was detected in soil sample A2S03.

No explosives were found in test pit A2TPA, despite identification of some debris as remnants of land mines. No pesticides or PCBs were detected in subsurface soil samples at this location. However, camphor was detected at low levels in a sample from 2 feet BGS in addition to numerous unknowns identified tentatively as alkane hydrocarbons. The contaminants may be related to an oily residue observed on magnets found in the test pit excavation. High concentrations of metals were also reported in the test pit samples.

Groundwater quality measured in 1992 indicated di-n-butyl phthalate (6.6 μg/L) in one of two samples from well EHA4. A low concentration of phosphate (15.9 μg/L) was detected in groundwater in June 1992, and at a similar level in October 1992. Aluminum and iron were elevated in the June round, but not in the subsequent round of sampling. The only other positive detections in groundwater were metals at background levels.

Removals

The three empty drums that were discovered on the western perimeter of Site A2 were removed. No readings above background were registered on the PID meter. Two of the drums had "partial contents" (OHM 1994) and were over-packed. No information could

be located concerning the nature of the contents in the two drums. All three drums were staged on the parking lot in front of Site P13.

2.2.2.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical sample and the TOC sample, were analyzed for TCL organics, TAL metals, explosives, and TPHC. A summary of Phase II Sampling Activities at Site A2 is provided as Table 2-8.

Table 2-8

PHASE II SAMPLING EFFORTS FOR SITE A2 — DEMOLITION GROUND I

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	2	08/31/93 12/03/93	Samples were collected to investigate groundwater quality and the potential for contaminant migration through the groundwater pathway.
Subsurface Soil	1	08/04/93	A sample was collected from the top of the saturated zone and sent for TOC analysis.
	1	08/04/93	One geotechnical sample was collected and sent for grain size and Atterberg limits analyses to assess the area's subsurface soils.
Surface Soils	6	08/02/93	Samples were collected to assess the nature of surface contamination in the demolition and ammunition testing impact area.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

In order to characterize groundwater quality at Site A2, E & E installed, developed and sampled one shallow overburden monitoring well. The well is located in the southeastern corner of the site outside of the bermed area used for demolition and testing of reject ammunition. This is along the eastern edge of the clearing, just west of the forested area which lies between Taylor Brook and the site. The monitoring well is screened downgradient of the site and across the water table within an interval 8 to 18 feet BGS. To assess groundwater quality and the potential for off-site contaminant migration, a total of two rounds of groundwater samples, with filtered and unfiltered samples collected at each round, were collected from the well during August and December 1993.

Subsurface Soil Sampling

During monitoring well installation, a subsurface soil sample was collected from the top of the saturated zone and analyzed for TOC. A sample was also collected for grain size and Atterberg limits analyses. The data from these samples will help assess the nature of subsurface soils in the area and their impact upon groundwater hydraulic conductivity.

Surface Soil Sampling

A total of six surface soil samples were collected from surface drainage channels, or areas with stressed vegetation or obvious discoloration. These samples were used to investigate the nature of surface contamination in the area immediately impacted by demolition and ammunition testing, and to assess the potential for the site to act as a contaminant source Watershed 1B.

2.2.2.7 Nature and Extent of Contamination

Analysis of groundwater samples collected in the August and December 1993 sampling rounds indicated elevated concentrations of aluminum (59,000 μg/L), arsenic (57.1 μg/L), chromium (108 μg/L), iron (73,000 μg/L), lead (29.6 μg/L), manganese (1700 μg/L), and nickel (102 μg/L) above groundwater screening values in unfiltered samples from the newly installed monitoring well E3–A02–M01. In filtered samples, however, the concentrations of metals dropped significantly and no metals were found at levels above screening levels. These results indicate that the elevated metals are due to suspended solids in the unfiltered sample and are not found in dissolved forms at levels of concern. Filtered sampling by OHM in 1992 of the EHA4 well (located just northeast of Site A2) detected aluminum and iron at elevated levels in only one of two sampling rounds. A summary of detections above preliminary screening levels is provided in Table 2-9. The chemical summary reports are included as Tables 2-10, 2-11, and 2-12 at the end of this site's discussion.

The only organic compound detected in sampling of well E3–A02–M01 was the pesticide δ–benzenehexachloride (0.026 μg/L). No screening value could be located for this compound. No pesticides were detected in previous sampling by OHM of the EHA4 well.

Analysis of surface soil sampling by E & E at Site A2 detected aluminum, antimony, arsenic, beryllium, cobalt, copper, iron, manganese, potassium, and zinc in some of the samples at levels above background. Beryllium was the only metal found at a concentration above the soil screening value at 0.462 μg/g (estimated), but this level is only slightly above the maximum background level of 0.446 μg/g, and is likely to reflect naturally occurring levels.

Previous soil sampling at the site by OHM indicated several concerns not identified in E & E sampling. Antimony (10.2 μg/g) was detected in one of the OHM soil samples at A2S02 and in one of the OHM test pits (34.2 μg/g at the 2-foot interval in A2TPA, located between two earthen berms) at concentrations above the soil screening value of 10 μg/g (MCP

Table 2-9

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE A2

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum (U)[1]	--	50	MA SMCL[3]	59,000	E3-A02-M01	1/1
	Aluminum (F)[2]	--			*		
	Arsenic(U)	--	50	MA MCL[4]	57.1	E3-A02-M01	1/1
	Arsenic(F)	--			<2.00	E3-A02-M01	0/1
	Chromium(U)	--	100	SDWA MCL[5]	108	E3-A02-M01	1/1
	Chromium(F)	--			<10.0	E3-A02-M01	0/1
	Iron(U)	--	300	MA SMCL	73,000	E3-A02-M01	1/1
	Iron(F)	--			*		
	Lead(U)	--	15	MA MCL	29.6	E3-A02-M01	1/1
	Lead(F)	--			<5.00	E3-A02-M01	0/1
	Manganese(U)	--	50	MA SMCL	1,700	E3-A02-M01	1/1
	Manganese(F)	--			44.4	E3-A02-M01	0/1
	Nickel(U)	--	100	SDWA MCL	102	E3-A02-M01	1/1
	Nickel(F)	--			<10.0	E3-A02-M01	0/1
SOIL (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[6]	0.462[7]	E3-A02-S01	1/6

*No value reported for filtered samples due to laboratory contamination.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MA MCL = Massachusetts Maximum Contaminant Level.
[5]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
[6]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[7]Value is estimated.

NOTE: Groundwater results only include those from E3-A02-M01.

Source: Ecology and Environment, Inc. 1994.

GW-1/S-1 soil value) but below the MCP GW-3/S-3 value of 40 μg/g. Antimony was not elevated in samples taken at the 4 and 6 foot intervals in test pit A2TPA, indicating limited surficial contamination. Arsenic (44 μg/g, maximum) was detected in two surface soil samples at A2S08 above the soil screening value of 30 μg/g (MCP GW-1/S-1 and MCP GW-3/S-3 soil values). While HMX was detected in one soil sample by OHM at an elevated level of 170 μg/g, this level was well below the soil screening value of 3900 μg/g (EPA Region III RBC for residential soil). Cadmium (370 μg/g) was found at the 2-foot interval in

OHM test pit A2TPA which is above the soil screening value of 30 $\mu g/g$ (MCP GW–1/S–1) and the MCP GW–3/S–3 value of 80 $\mu g/g$, but below the EPA Region III RBC level for commercial/industrial soils of 510 $\mu g/g$. Cadmium was not detected at elevated levels in the samples taken in this same pit at the 4 and 6 foot intervals, indicating limited surficial contamination. Manganese (420 $\mu g/g$) was detected in the A2TPA at the 6-foot interval which is slightly above the soil screening value of 390 $\mu g/g$ (MCP GW–1/S–1). However, this value is higher than the shallower samples taken in the test pit, which may indicate that this level is reflective of natural levels.

One explosive compound, 2,4,6-trinitrotoluene (3.49 $\mu g/g$) was detected in E & E sampling in one of six samples taken at this site (E3–A02–S02 from the western berm). The concentration of this explosive was well below the soils screening value of 21 $\mu g/g$ (EPA Region III RBC for residential soils).

DDT, and its degration products DDE and DDD, were detected in several soil samples, but at levels below the maximum background detection. TPHCs (21.1 $\mu g/g$, maximum) were detected in five out of six soil samples, all detections at concentrations well below the soils screening value of 500 $\mu g/g$ (MCP GW–1/S–1).

2.2.2.8 Conclusions and Recommendations

E & E sampling of groundwater and soils at this site did not confirm any previously-detected contaminant migration through surficial runoff or into groundwater. While some elevated levels of metals were detected in unfiltered groundwater samples, elevated levels were not found in filtered samples taken at well E3-A02-M01, indicating that dissolved forms of these metals were not present in the groundwater at levels of concern. While trace levels of explosives were detected in one out of six soil samples, the concentration detected was below screening values. Low residual concentrations of explosives may be related to the demolition activities which occurred at this site. Aluminum and iron were elevated in one of two rounds of groundwater sampling of well EHA4 by OHM, probably due to seasonal variation and naturally occurring levels of these metals.

Previous soil sampling at Site A2 indicates some surficial antimony, arsenic, and HMX contamination in the central area of this site as indicated by sampling results from soil samples A2S02, A2S03, and A2S08. In addition, some shallow subsurface soils in the central area may be contaminated with antimony and cadmium as indicated by the results from OHM test pit A2TPA. E & E sampling in the runoff paths from the central demolition area indicates that contaminants are not migrating in surficial runoff from the site.

Given the presence of a limited area of soil contaminated with HMX, antimony, arsenic, and cadmium in the central demolition area, further action is recommended at this site. A removal of the limited area of contaminated soil should be considered.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-10
Chemical Summary Report For Groundwater
Site: A02
Units: UGL

	Site ID	E3-A02-M01	E3-A02-M01	E3-A02-M01	E3-A02-M01		
	Field Sample ID	MFA02011	MFA02012	MXA02011	MXA02012		
	Sample Date	08/31/93	12/03/93	08/31/93	12/03/93		
Test	Parameter .						
TAL METAL	Aluminum	28.0 B	17.8 BJ	59000 @	26000 @		
	Antimony	4.10 BJ	7.16 B@	< 5.00	2.66 J		
	Arsenic	< 2.00	< 2.00	57.1 J@	38.0		
	Barium	6.07 J	4.76 J	289	122		
	Beryllium	< 5.00	< 5.00	3.56 J	1.27 J		
	Cadmium	< 5.00	< 5.00	2.82 J	< 5.00		
	Calcium	2810	2720	9900	5320		
	Chromium	< 10.0	< 10.0	108 @	34.4		
	Cobalt	< 10.0	< 10.0	50.3	18.2		
	Copper	< 10.0	< 10.0	91.8	39.1		
	Iron	16.7 BJ	15.5 BJ	73000 @	30000 @		
	Lead	< 5.00	< 5.00	29.6 @	20.4 @		
	Magnesium	933	839	19600	7210		
	Manganese	44.4	21.0 K	1700 @	878 @		
	Nickel	< 10.0	< 10.0	102 @	40.1		
	Potassium	836 J	< 1000	13000	5090		
	Sodium	3050	2310 B	5500	3110 B		
	Vanadium	< 10.0	< 10.0	121	44.0		
	Zinc	10.8 BJ	10.8 BJ	152	62.7		
TCL Pest	delta-BHC			0.026	< 0.020		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 2-11
Chemical Summary Report For Subsurface Soils
Site: A02
Units: UGG

	Site ID	E3-A02-M01					
	Field Sample ID	BX0201X1					
	Sample Date	08/04/93					
Test	Parameter Depth	9.0 ft.					
TOC	Total Organic Carbon	22700					

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-12
Chemical Summary Report For Surficial Soils
Site: A02
Units: UGG

Test	Site ID	E3-A02-S01	E3-A02-S02	E3-A02-S03	E3-A02-S04	E3-A02-S04	E3-A02-S05
	Field Sample ID	SX0201X1	SX0202X1	SX0203X1	SX0204X1	SX0204X1	SX0205X1
	Sample Date	08/02/93	08/02/93	08/02/93	08/02/93	08/03/93	08/02/93
Test	Parameter						
EXPLOSIVES	2,4,6-Trinitrotoluene	< 1.00	3.49 C	< 1.00	< 1.00		< 1.00
TAL METAL	Aluminum	11000 !	6500	6100	6900		6800
	Antimony	0.984 K!	< 0.500 R	< 0.500 R	< 0.500 R		2.31 J!
	Arsenic	19.0 !	4.10	5.32	6.75		15.0 !
	Barium	21.4	14.4	12.2	21.5		36.5 !
	Beryllium	0.462 J!@	0.285 J	0.246 J	0.290 J		0.282 J
	Calcium	< 500	< 500	376 J	< 500		< 500
	Chromium	13.5	12.7	12.5	11.8		9.91
	Cobalt	5.34	5.72	6.28 !	5.25		4.58
	Copper	11.4 !	7.07	7.92	11.6 !		34.6 !
	Iron	11000	8900	17000 !	10000		10000
	Lead	7.76 J	8.69 J	4.84 J	5.52 J		19.0 J
	Magnesium	1590	2010	1860	1950		1320
	Manganese	92.3	111 !	130 !	95.7		93.2
	Nickel	9.71	9.29	9.92	8.63		7.97
	Potassium	415 K	779 !	844 !	1210 !		512 K
	Selenium	0.424 J	< 0.200 J	< 0.200 J	< 0.200 J		< 0.200 J
	Thallium	< 0.500	0.163 J	< 0.500	< 0.500		< 0.500
	Vanadium	17.5	18.2	15.7	15.1		11.7
	Zinc	26.9	20.6	21.3	20.0		52.6 !
TCL BNA	C16			0.190			
TCL Pest	P,P-DDD	< 0.002	< 0.100	< 0.020	< 0.010		< 0.010
	P,P-DDE	0.007 C	< 0.100	0.050 C	< 0.010		0.017 C
	P,P-DDT	0.008 C	< 0.100	0.054 C	0.006 JC		0.042 C
TPHC	Total Petroleum Hydrocarbon	21.1 J	16.0 J	19.8 J	< 20.0		14.8 J

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 2-12
Chemical Summary Report For Surficial Soils
Site: A02
Units: UGG

	Site ID	E3-A02-S06					
	Field Sample ID	SX0206X1					
	Sample Date	08/02/93					
Test	Parameter .						
EXPLOSIVES	2,4,6-Trinitrotoluene	< 1.00					
TAL METAL	Aluminum	4600					
	Antimony	< 0.500 R					
	Arsenic	4.70					
	Barium	16.8					
	Beryllium	0.187 J					
	Calcium	327 J					
	Chromium	11.0					
	Cobalt	5.12					
	Copper	5.48					
	Iron	6900					
	Lead	2.66 J					
	Magnesium	1920					
	Manganese	85.9					
	Nickel	8.45					
	Potassium	957 !					
	Selenium	< 0.200 J					
	Thallium	< 0.500					
	Vanadium	11.1					
	Zinc	16.6					
TCL BNA	C16						
TCL Pest	P,P-DDD	0.002 JC					
	P,P-DDE	0.004 JC					
	P,P-DDT	0.013 C					
TPHC	Total Petroleum Hydrocarbon	19.7 J					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

2.2.3 Site P11 — Building T405 Area

Site P11 was identified during interviews in 1990 with Natick Laboratory employees as a possible location used for the disposal or dumping of chemicals. Figure 2-4 provides a map of Site P11.

2.2.3.1 Site Location

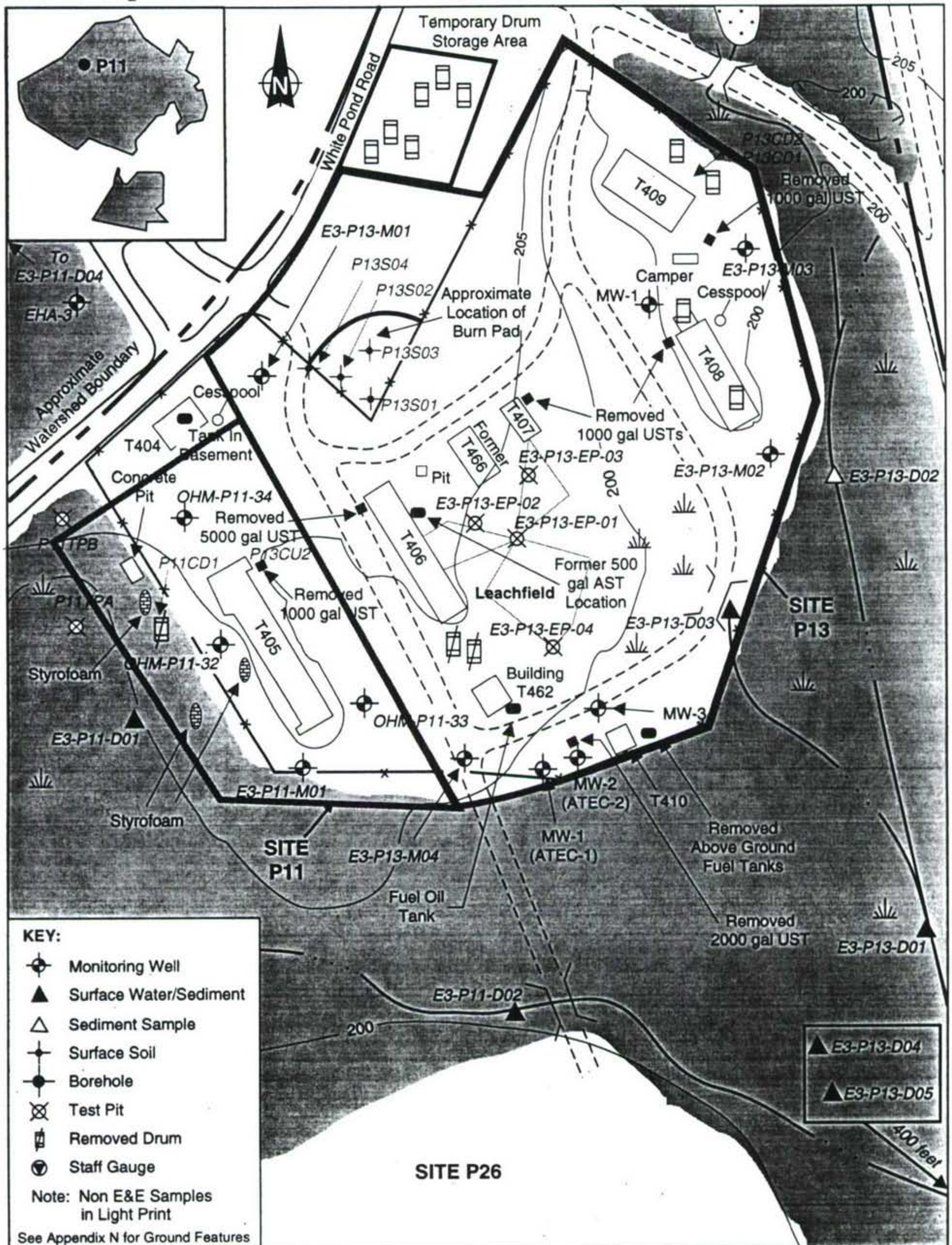
Site P11 is located in the western area of the Annex and on the southern side of White Pond Road. The site consists of Building T405 and an area to the west of it beyond the barbed wire fence. A 9 foot by 12 foot styrofoam structure exists about 60 feet west of Building T405. About 40 feet southwest of the first structure lies a 15 foot by 30 foot styrofoam structure beyond the wire fence. West of Building T405, beyond the fence, there is an 8 foot long by 6 foot wide by 10 foot deep concrete-lined pit. Two more small styrofoam structures also exist in this area. The terrain 100 feet west of the wire fence is a wetland sparsely covered with trees.

2.2.3.2 Physical Characteristics

Site P11 is located in an area of glacial outwash sand and gravel, lying between two hills of till, a drumlin to the east and a ground moraine with bedrock outcrops to the west. Surface elevations at Site P11 range from 200 to 205 feet AMSL. The average groundwater elevation is 194 feet AMSL.

Three monitoring wells (OHM-P11-32, OHM-P11-33, and OHM-P11-34) were installed at Site P11 by OHM in 1992, and an additional monitoring well (E3-P11-M01) was installed by E & E in 1993. Two samples were collected from the boring at E3-P11-M01 and submitted for grain size and Atterberg limits analyses. Soil from the 6 to 8 foot interval was identified as silty clay with low plasticity (liquid limit less than 35) while soil from the 9 to 11 foot interval was identified as non-plastic sandy silt. Borings at locations OHM-P11-34, north of Building T405, and E3-P11-M01, south of Building T405 encountered sand, with silt and gravel typical of an outwash plain, to total depths of 18 feet and 19 feet, respectively. Borings at locations OHM-P11-32, west of Building T405, and E3-P11-33, east of Building T405 encountered similar outwash to depths of 8 and 10 feet, respectively. The remaining length of each boring (8 to 16 feet at OHM-P11-32, and 10 to 17 feet at OHM-P11-33) extended through a dense, gravel, sand clay, silt layer. Together, this information seems to indicate the presence of a ridge or small mound of till stretching east to west beneath Building T405. Additional geotechnical analysis was performed on three sediment samples collected at P11. Sediment samples E3-P11-D01 and E3-P11-D02 were both identified as silty sand with very high plasticity (liquid limit more than 70). Sediment sample E3-P11-D03 was classified as non-plastic, poorly graded sand. Appendix D contains a complete summary of geotechnical results. Bedrock was not encountered during subsurface explorations, but is projected to be Gospel Hill Gneiss (Hansen 1956). Depth to bedrock is unknown, but it is probably shallow (50 feet). The seismic survey inferred top of bedrock at 150 to 160 feet AMSL beneath Building T405.

11: SUDBURY\UC6_P11B.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 2-4 MAP OF SITE P11, BUILDING T405 DUMP AREA

Based on slug test data collected at wells OHM–P11–32, OHM–P11–33, and OHM–P11–34 in 1992, an average transmissivity of 200 feet^2 per day was calculated by OHM. This calculation was made using the geometric mean of measured hydraulic conductivities at each well, and an average aquifer thickness of 30 feet. This low number may be an underestimate of actual transmissivity within the outwash layer due to the fact that two of the wells (OHM–P11–32 and OHM–P11–33) are partially set in till. The basis of the aquifer thickness estimate is unclear, but the aquifer clearly falls into the category of a low productivity aquifer (less than 1,350 feet^2 per day), as defined in 310 CMR 40.0006.

In 1993, E & E conducted a slug test at E3–P11–M01. A transmissivity of 52.65 feet^2 per day was calculated, based on a presumed aquifer thickness equal to the length of the water column in the well. The transmissivity was calculated as follows:

$$T = Kb$$
$$T = (6.003)\ (8.77)$$
$$T = 52.65 \text{ feet}^2 \text{ per day}$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer thickness (feet)

Appendix G contains complete slug test data and interpretation. This transmissivity may be slightly underestimated because of the conservative aquifer thickness assumption.

The boundary between Watershed 1B — Lower Taylor Brook and Watershed 3 — Lower Assabet River is defined by White Pond Road northeast of the site. Surface water at Site P11 flows south and southeast to adjacent wetlands, which are in turn drained by Honey Brook, but these drainage ways are typically dry at the end of summer. See groundwater elevations, geotechnical data (Appendix D), hydrogeologic data (Appendix G), and results of a seismic survey (Appendix E).

Water table elevations from monitoring wells at Site P11/P13 (Appendix P) were interpreted to imply a groundwater divide, passing under Buildings T405, P406, and T408. Flow on the south side (southeast side), is then towards Honey Brook, and flow on the north side is towards the Assabet River, or to the spring some 400 feet northwest of the entrance to Site P13 from White Pond Road. The springs appears to be a perennial discharge point for groundwater, and is the source of a small wetland and unnamed stream that flow north to the Assabet River.

The presence of the groundwater divide is also inferred from the seismic data which describe an even more complex water table with the groundwater divide sinuously winding across the site through Building T405, north of Building T406, and south of Building T408, but the survey did not extend to the area of well E3-P13-M03, which shows the highest water table elevation on site (see Figure 3-6, Appendix E). It should be noted that the interpreted

water table from the seismic survey only agrees in a general way with the data from monitoring wells, and that the latter data are much more likely to be accurate.

2.2.3.3 Ecological Characterization

Site P11 and Site P13 (MFFA) are adjacent to each other in the western part of the Annex, on the southern side of White Pond Road. In July 1993, E & E conducted a field survey which included identification of the vegetation cover-types, wetland boundaries, and the plants and animals in the general area of the site. Based on this field survey three upland communities and two wetland communities were identified.

Upland Communities

Three different upland plant communities were identified at Sites P11 and P13: open/disturbed, aspen forest, and red maple-white pine forest. The open/disturbed area is located around the abandoned buildings, roads, and sidewalks in the central portion of the site. This area consists primarily of orchard grass and Kentucky bluegrass, although a few multiflora rose, white ash, and blueberry shrubs/saplings are located around the buildings. In addition, a few red maple black locust and red cedar trees are scattered throughout this area.

The aspen forest is located in the northeastern corner of the site, and includes quaking aspen, red oak, white pine, and shagbark hickory in the overstory. The moderately dense understory consists of red maple, flowering dogwood, and overstory regeneration. In addition, poison ivy and Virginia creeper are common vines. Various asters, grasses, and goldenrods comprise the sparsely vegetated herbaceous layer.

The red maple-white pine forest is located between the open/disturbed area and the surrounding wetlands. The dense overstory is dominated by red maple, but also includes white pine, black cherry, and slippery elm. The understory is very sparse and consists of red maple, red oak, and silky dogwood. Poison ivy dominates the ground cover.

In general these areas combine several distinct upland habitats which support wildlife. The open disturbed area is considered to be of moderate value to wildlife providing seeds and berries which can be eaten by many species of birds and small mammals. The aspen and the red maple-white pine forests may support numerous species of songbirds, upland gamebirds, small mammals, and deer since they provide cover and food (acorns, nuts, catkins, seeds, and berries) (Martin *et al*. 1951).

Wetland Communities

Two distinct wetland habitats have been identified in the vicinity of the site are an extensive forested/scrub-shrub wetland and an emergent wetland. Surface water from the site drains to the south and southeast into two unnamed intermittent streams, one on the eastern edge of the site and the other on the southern edge. The two streams converge southeast of Sites P11 and P13 and then flow south towards Honey Brook. A small vernal pool referred

to as North Gate Pool (Butler 1992) is located approximately 1,000 feet north of the site. This vernal pool was not characterized during the field survey.

Associated with the two tributaries and surrounding most of the area except for the western part, is a forested/scrub-shrub wetland. The relatively dense overstory of this wetland consists primarily of red maples. The understory includes highbush blueberry, and red maple saplings. The herbaceous layer consists of skunk cabbage, cinnamon fern, sphagnum moss, and grasses. No woody vines occur in this area.

The emergent wetland is located in the northeastern portion of the open/disturbed area. This wetland, devoid of overstory vegetation, appears to have been cleared or cut in the past. The relatively sparse understory includes scattered meadowsweet, highbush blueberry, and northern arrowwood shrubs. The densely growing herbaceous layer is composed of sensitive fern, slender blue iris, cutgrass, tear thumb, and cinnamon fern.

Scarboro muck is the underlying soil in both wetland areas and is listed by the County Soil Conservation Service (SCS) as a hydric soil (USDA 1987). Hydric characteristics observed during the soil analysis conducted in July 1993 included a low matrix chroma (black muck) with no mottles. Wetland hydrology indicators associated with these wetlands included soil saturation in the upper twelve inches, wetland drainage pattern, shallow roots, and sediment-stained leaves for both wetland types.

In general, these wetland areas include three different habitat types: forested wetland, emergent wetland, and open water intermittent stream and vernal pool. Forested and emergent wetlands combine several woody and emergent plant species to provide food and cover, consequently attracting many kinds of wildlife species. Open water areas such as North Gate Pool and intermittent streams constitute valuable environments that attract many species of insects, reptiles, amphibians, birds, and upland wildlife.

Species of Concern

Several species of concern have been documented in the vicinity of Sites P11 and P13. These include the following state watch-list species: midland sedge (*Carex mesochore*a), found on the southern edge of the site; small beggar ticks (B*idens discoidea*), identified 300 feet northeast of the site; lacegrass (*Eragrostis capillaries*), found on artificial sand mounds on site (Hunt 1992), and Grass-leaved Ladies' Tress (*Spiralis Vernalis*), identified in the unmoved field in the Taylor Drop Zone, northwest of the site (Aneptek 1991). In addition, eggs of the blue-spotted salamander (*Ambystoma laterale*), a species of special concern in Massachusetts, were observed in the North Gate Pool (Butler 1992). No unique habitats have been identified in the general vicinity of the site (NHESP 1992).

2.2.3.4 Site History

Site P11 consists of an area identified during interviews with Natick Laboratory employees (Interview 1990A). The Natick Laboratory employees indicated chemical dumping and burial may have occurred in and along the south sides of the fence to the west of Building

T405. The probable source of the chemicals disposed of at the site is from research conducted within Building T405.

Site P11 appeared to be open fields in 1940 photographs, possibly being used as farm land. Building T405 was constructed in 1952, and was identified as lying within the area likely to have been used for ordnance research and development from 1952 to 1957 (MOTS period). A 1955 map identifies Building T405 as the "barricade" building. No further details on the use of the building during the MOTS period could be identified.

From 1957 until 1982, T405 was the center of much of the laboratory research conducted at the Annex during the Natick period. Research was conducted by the following divisions of Natick Laboratories: the Pioneering Research Division (PRD), the Aero-Mechanical Engineering Laboratory (AMEL), the Clothing Equipment and Material Engineering Laboratory (CEMEL), and possibly the Food Division. Research was also conducted by Harvard University (under contract) for the PRD in 1959, and possibly during other years. Other Natick divisions may also have used the building. Research conducted in the building can be divided into four broad areas: fiberglass and polyurethane foam structures; basic chemical research into organic compound reactions under high pressure and temperature; impact testing using a shock tube; and insecticide, rodenticide, and defoliant research.

An interview with a Natick employee (Interview 1990A) noted that work on fiberglass and polyurethane foam structures was being conducted in 1962. Workers would spray fiberglass and polymer to form foam structures, some of which are still present behind and west of Building T405. The employee remembered using toluene, benzene, methanol, methyl ethyl ketone (MEK), acetone, peroxide, and other chemicals which were stored in bunkers at the Annex. Decontamination water from cleaning spray equipment went into 5-gallon cans and 55-gallon drums. Spray heads were cleaned by spraying them out into the air.

The rooms in Building T405 are also reportedly "explosion proof" and may have been used for chemical mixing. The Natick Environmental Assessment (NARADCOM 1978) noted that the CEMEL used portions of Building T405 to mix chemicals. High pressure and high temperature equipment was recorded as being installed in the building and used for studying organic synthetic reactions at high pressure.

The presence of large ovens, sometime between 1964 and 1979, were also noted by another Natick employee (Interview 1992A). Flame testing was also recorded as being conducted in the building. The AMEL used a major portion of the building for a large shock tube in order to test the effect of stresses and strain on systems. Building T405 was also the location of some defoliant, rodenticide, and insecticide research sometime in the early to mid-1960s.

During a visit in 1962, the AEHA identified the use of toluene-2,4-diisocyanate, amine hardeners, MEK, and peroxide in T405. Other chemical material, in addition to those mentioned by Natick employees and AEHA, such as pesticides, herbicides, or rodenticides could also be present in Site P11.

The Massachusetts Army National Guard apparently used Building T405 as part of their training activities sometime after 1971. Real property records indicate that Building T405 had a 1,000-gallon steel UST for No. 2 Fuel Oil and two cesspools as part of a septic system. The UST was removed in 1992.

2.2.3.5 Results of Previous Investigations

A hydrogeological assessment was performed by AEHA in 1983. A Phase I SI was conducted by OHM in 1992, and included a soil-gas survey, a geophysical study, test pit excavations with subsurface soil sampling, monitoring well installation with groundwater sampling, removal of an empty drum with confirmatory sampling, and sediment sampling. All samples were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, and TAL metals.

In 1983, AEHA installed and sampled monitoring well EHA3 north of Site P11 across White Pond Road. Only nitrogen in the form of nitrite and nitrate (3 μg/L) was found.

Activities conducted by OHM at Site P11 through 1991 are detailed in Section 7.20 of the January 1994 *Final Site/Remedial Investigation Report* (OHM 1994). The soil-gas survey did not detect any chlorinated hydrocarbons or BTEX constituents. Total PID volatiles were found at 20 locations clustered near the wetland west of Site P11.

In 1992, three more wells were drilled and sampled along with the preexisting EHA3 well. A groundwater sample from well OHM–P11–33 contained toluene (34 μg/L) in June 1992, and toluene (6.7 μg/L) in November 1992. Several metals were also present at anomalous concentrations: aluminum (1,300 μg/L), calcium (69,000 μg/L), chromium (23.3 μg/L), and vanadium (42.4 μg/L). In the November sampling round, chromium was not present and all the other metals were detected at lower concentrations than during the June sampling. The highest concentration of arsenic (7.63 μg/L) was detected in November 1992. OHM–P11–33 also contained DDT (0.07 μg/L), endrin (0.043 μg/L), heptachlor epoxide (0.026 μg/L), α–chlordane (0.261 μg/L), and β–endosulfan (0.022 μg/L) in the June sampling round. No pesticides were detected during the November sampling. When compared to background levels, EHA3 contained a higher level of potassium (4.59 μg/L) in June 1992, and sodium (22,000 μg/L) in November 1992. The latter probably is caused by road salting on White Pond Road.

Geophysical studies detected numerous electromagnetic and magnetic anomalies caused by buildings, chain link fence, and scrap metal. Several test pits were excavated, but no material was uncovered in the process. Test pit grab samples for VOCs and composite samples for other parameters were collected. The only metal that exceeded background soil levels in the monitoring well boring and test pit samples was potassium (2,130 μg/g) which is not of concern for human health or the environment.

Removals

One drum located at Site P11 was removed and staged at the temporary storage area created by OHM on the parking lot at the entrance to Site P11. An elevated concentration of lead (24 $\mu g/g$) was present in the drum confirmation sample (P11CD1). DDT (0.035 $\mu g/g$), DDD (0.035 $\mu g/g$), and DDE (0.059 $\mu g/g$) were detected.

The 1,000-gallon UST was removed in May 1992 by ATEC, Inc. under contract to Fort Devens. Upon excavation, the tank was observed to be in good condition. Two soil samples (LSS-1 and LSS-2) were obtained for laboratory analysis. Analytical results of the sample from the edge of the excavated area did not detect any TPHC above the reporting limit while the analysis of the sample obtained from the bottom of the excavation, LSS-2, revealed TPHC (23 ppm). Analysis of two additional composite soil samples from two soil borings (S.B. 95-1 and S.B. 95-2) advanced to a depth of 12 feet revealed no detectable levels of pesticides. Analysis of P13CU2, a sample collected by OHM during the excavation of the UST, did not detect any pesticides or TPHC. The soil samples were obtained from the excavation by ATEC for field screening and analysis using a PID and NDIR analysis. The PID results indicated no detectable total organic volatiles (TOV) concentrations, while Non-Disperse Infra Red Spectroscopy (NDIR) concentrations revealed TPHC concentrations from 7.5 ppm to 63.1 ppm. The excavation was backfilled with sand and with native soil, which was excavated to free the tank. ATEC recommended no further action.

2.2.3.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of geotechnical and TOC samples, were analyzed for TCL organics, TAL metals, TPHC, and herbicides on the Drinking Water Standard. A summary of Phase II Sampling Activities at Site P11 is provided as Table 2-13.

Geophysical Investigations

Geophysical investigations were conducted adjacent to Site P11 and are discussed in the Site P13 SI report. However, a thorough reconnaissance survey of the area immediately surrounding Buildings T404 and T405 identified two septic tanks and vent pipes which probably were used for each building.

Groundwater Sampling

In order to characterize groundwater quality at Site P11, E & E installed, developed, and sampled one shallow overburden monitoring well, E3-P11-M01. The well was installed downgradient of Building T405, in the southeastern corner of the clearing where Sites P11 and P13 are located. The well is screened across the water table at an interval of 6 to 16 feet BGS. In addition to the newly installed well, E & E also sampled five existing monitoring wells to further assess groundwater quality and the potential for contaminant migration. Five

Table 2-13

PHASE II SAMPLING EFFORTS AT SITE P11 — BUILDING T405 AREA

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	5 from round 1; 6 from round 2	08/24/93 08/25/93 09/02/93 11/30/93	Samples were collected to characterize groundwater quality and the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	1	08/03/93	Sample collected from the saturated zone for TOC analysis.
	1	08/03/93	Geotechnical sample collected to help assess nature of subsurface soils and their impact upon groundwater hydraulic conductivity.
Surface Water	5	09/15/93 12/01/93 12/02/93 04/26/94	The surface water and sediment samples were collected to investigate the impact of past site activities on the streams in the area and the potential for the streams and wetland areas to act as future contaminant sources.
Sediment	5	08/03/93 09/01/93 09/15/93 12/02/93 04/26/94	See surface water sampling rationale.
	3	08/03/93 09/15/93	Samples collected for TOC analysis.
	3	08/03/93 09/15/93	Geotechnical samples were collected at location E3-P11-D01, E3-P11-D02, and E3-P11-D03 to characterize the nature of sediment.

Source: Ecology and Environment, Inc. 1994.

of the six wells were sampled during two groundwater sampling events in August and December 1993. Both filtered and unfiltered samples were collected at each well during both sampling rounds. The sixth well, EHA3, was sampled only once during the final round in December 1993. The eleven samples from both groundwater sampling events in August and December 1993, were used to characterize the groundwater pathway as a potential source of environmental degradation and contaminant migration. Additional wells were added to the original site sampling plan after field observations identified existing wells in locations downgradient of potential sources. The additional samples were added to further characterize groundwater quality and investigate the presence of any contaminant plumes in the groundwater pathway.

Subsurface Soil Sampling

During the installation of monitoring well E3-P11-M01, a sample was collected from the saturated zone and sent for TOC analysis. In addition, geotechnical samples were collected during the well's installation from the screened interval and sent for grain size and Atterberg limits analyses.

Surface Water and Sediment Sampling

A total of five surface water and four sediment samples (at four locations) were collected from wetlands, streams, and groundwater seeps, which lie downgradient of Building T405 and Site P11. These ten samples were collected in order to assess the nature of contamination in the surface water pathway and the potential for the pathway to act as a source of future contaminant migration. The third and fourth sample locations were added to the original site sampling plan for two basic reasons. One location was added to corroborate existing data from a rapid bioassessment (RBA) sampling point, while the other location was added to further assess contamination from a previously unidentified groundwater discharge point.

One of the sampling locations is in the wetlands area and intermittent streambed which lies south of Building T405. Sample location E3-P11-D01 was chosen downgradient of the clearing surrounding Building T405 and lies below a surface drainage pathway which fed the wetlands area. Sample location E3-P11-D02 was chosen further downstream of the first sampling location, after the intermittent stream changes from a southeasterly to northeasterly flow direction. The third sample location, E3-P11-D03, was chosen from a location downstream of three sites, P11, P13, and P26. This sample location was chosen to corroborate chemical data with biological data collected from a RBA sampling point measured in May 1993. The RBA sampling point and E3-P11-D03 surface water and sediment sampling location lie in Honey Brook, approximately 50 feet northeast of the point where Puffer Road crosses Honey Brook. The fourth sampling location, E3-P11-D04, was chosen to characterize a groundwater seep which may be receiving groundwater flow from the northern portion of Site P11. The seep is on the east bank of a streambed running in a northerly direction and located approximately 600 feet north of Site P11 across White Pond Road.

Geotechnical samples were collected from the surface water and sediment sampling locations and sent for grain size and Atterberg limits analyses. The samples provide data to characterize the stream sediments, their impact upon the surface water pathway, and the potential for contaminant migration. Sediment samples were also analyzed for TOC.

Due to the relatively dry summer, only sediment samples could be collected from sample locations E3-P11-D01 and E3-P11-D02 during the August 1993 sampling event. However, both surface water and sediment samples were collected from location E3-P11-D03 in September 1993. To complete the original work plan sampling requirements, surface water samples from locations E3-P11-D01 and E3-P11-D02 were collected during the relatively wet December 1993 sampling event. In addition, during the December sampling event,

surface water and sediment samples were collected from the groundwater seep, at location E3–P11–D04. Due to the presence of sediments in the December 1993 surface water sample of E3-P11-D04, this location was resampled in April 1994. A small basin was excavated with a shovel, 24 hours prior to sampling to ensure a sediment-free surface water sample.

As a result of the QA/QC protocols approved in the QAPjP, E & E recollected surface water and sediment samples from E3-P11-D02 in September 1993 and analyzed them for herbicides.

2.2.3.7 Nature and Extent of Contamination

Analysis of an unfiltered groundwater sample from the EHA3 well, which is located approximately 75 feet northwest of White Pond Road, indicated aluminum (122 μg/L) and iron (745 μg/L) above screening levels. These levels are probably due to suspended solids. No compounds were found in the filtered sample above screening levels. Given the location of the EHA3 well in the northern groundwater divide from Sites P11 and P13, these results seem to indicate no impact on groundwater in this area for Sites P11 and P13. A summary of detections above preliminary screening levels is provided in Table 2-14. The chemical summary reports are included at the end of Section 2.2.3 in Tables 2-15, 2-16, 2-17, and 2–18.

In the December 1993 surface water sample (E3–P11–D04) taken from the groundwater seep located across White Pond Road, north of Site P11, mercury was detected at 0.244 μg/L, which is above the surface water screening value (MA/CWA WQC for consumption of water and fish of 0.14 μg/L). Because the source of this water could include groundwater from the northern side of Site P11 (in addition to drainage from Site A8/P10 and Site P13), the mercury result was also compared to the groundwater screening value and found to be below the SDWA MCL of 2 μg/L. However, this surface water at the seep was barely flowing at the time of sampling and the sample contained a large amount of suspended solids. Arsenic, copper, cadmium, lead, and nickel were also found above screening levels in this surface water sample, and are also thought to be the result of suspended solids in the sample. The relatively high metals levels in the December 1993 sample is confirmed to be the result of suspended solids by comparison with a sample from the same location taken in April 1994. The results of data of the resampling on 26 April 1994 show that the sample had no constituents that exceeded surface water screening levels. The low TSS of 5 μg/L shows that a non-turbid sample of the groundwater at its discharge point to surface water contains no detectable mercury, lead, arsenic, antimony, chromium, cobalt, nickel, or thallium. This sample did contain low levels of silver, barium, beryllium, copper, vanadium, and zinc, none of which exceed any screening levels. Given that none of these metals were elevated in the groundwater sample taken at the EHA3 well, which is between Site P11/P13 and the groundwater seep, these metals are probably not related to Site P11/P13.

Reconnaissance of the area around the groundwater seep in April 1994 revealed the presence of a hillside debris dump. Much of the debris appeared to be decades old, and

Table 2-14

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P11

Medium (Units)	Compound	Maximum Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum (U)[1] Aluminum (F)[2]	-- --	50	MA SMCL[3]	37,000*	E3-P11-M01	4/4
	Iron (U) Iron (F)	-- --	300	MA SMCL	41,000*	E3-P11-M01 E3-P11-M01	4/4
	Lead (U) Lead (F)	-- --	15	MA MCL[4]	17.1 <5.00	E3-P11-M01 E3-P11-M01	1/3 0/4
	Manganese (U) Manganese (F)	-- --	50	MA SMCL	621 212	E3-P11-M01 E3-P11-M01	1/4 1/1
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[5] (for cons. of water and fish)	7.01	E3-P11-D03	3/4
	Iron	4810	1000	MA/CWA WQC (for aq. life)	1,580	E3-P11-D03	2/4
	Lead	10.3	3.2	MA/CWA WQC (for aq. life)	21.6	E3-P11-D01	1/4
SED (μg/g)	Arsenic	2.03	6	Ontario MOE LEL	11.6	E3-P11-D04	1/5
	Lead	4.48	31	Ontario MOE LEL[6]	34.0	E3-P11-D01	2/5
	Nickel	5.92	16	Ontario MOE LEL	26.0	E3-P11-D04	1/5
	Silver	<0.200	0.5	Ontario MOE LEL	1.89	E3-P11-D04	1/5
	Anthracene	--	0.085	NOAA ERL[7]	0.210	E3-P11-D03	1/4
	Benzo(a)anthracene	--	0.23	NOAA ERL	1.20	E3-P11-D03	1/4
	Benzo(a)pyrene	--	0.4	NOAA ERL	0.870	E3-P11-D03	1/4
	Benzo(b)fluoranthene	--	0.7	MCP GW-1/S-3[8]	1.40	E3-P11-D03	1/4
	Chrysene	--	0.4	NOAA ERL	1.00	E3-P11-D03	1/4
	Fluoranthene	--	0.6	NOAA ERL	1.80	E3-P11-D03	1/4
	Phenanthrene	--	0.225	NOAA ERL	0.510	E3-P11-D03	1/4
	Pyrene	--	0.35	NOAA ERL	1.40	E3-P11-D03	1/4
	DDD	--	0.002	NOAA ERL	0.100	E3-P11-D02	1/4
	DDE	--	0.002	NOAA ERL	0.079	E3-P11-D02	3/4
	DDT	--	0.001	NOAA ERL	0.038(J)[9]	E3-P11-D02	2/4
	TPHC	16.6	2	Ontario MOE LEL	106	E3-P11-D04	1/5

*No results reported for filtered samples due to laboratory contamination.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MA MCL = Massachusetts Maximum Contaminant Level.
[5]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria.
[6]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[7]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range - Low.
[8]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[9] J = Value is estimated.

Note: Surface water sample results at E3-P11-D04 for April 1994 are included in this table, but those taken in December 1993 are not included due to the high sediment content of the surface water sample taken at that time. Wells included in this table are E3-P11-M01, M-P11-32, OHM-P11-33, and EHA3.

Source: Ecology and Environment, Inc. 1994.

included various pieces of metal and glassware. Some of the detections in the surface water/sediment samples at the seep may be related to this debris.

In the sediment sample taken in December 1993 at the groundwater seep, arsenic (11.6 μg/g), nickel (26.0 μg/g), and silver (1.89 μg/g) were found above background and screening levels. However, the concentrations of these metals were below the NOAA ERM levels. Although those concentrations were above screening levels, the metals were not elevated in groundwater at Site P11/P13 or Site A8/P10, and their source is either natural or related to the debris in the hillside at the seep. No pesticides were detected in the sediment sample taken in December 1993 at the groundwater seep. TPHCs were detected at 106 μg/g, which is above the lowest effect level for TPHC used for screening of 2 μg/g (Ontario MOE LEL). This level is well below the soil screening value for TPHC of 500 μg/g.

The groundwater seep was resampled in April 1994 and the sediment sample was analyzed for metals, TOC, and TPHC. While several metals were found in concentrations above sediment background levels, only lead (33.0 μg/g) was above screening levels.

Given the possible chemical dumping at the site and the detection of toluene in groundwater at well OHM-P11-33 in 1992, the key concern for groundwater at this site is the presence of VOCs and other compounds that might confirm an impact from potential dumping. However, no volatile or semivolatile compounds were detected in groundwater samples taken in the two downgradient wells to the south of Building T405 (E3-P11-M01 and OHM-P11-33), and in the well immediately west of the building (OHM-P11-32) nor were TPHCs above the detection limit.

In the well immediately west of Building T405 (OHM-P11-32), aluminum and iron were elevated above screening values in unfiltered samples. No results were reported for these metals in filtered samples due to laboratory or field contamination. No other contaminants of concern were detected in groundwater sampling at this well.

In the downgradient wells south of the site (E3-P11-M01 and OHM-P11-33), aluminum and iron were elevated above screening values in unfiltered samples. No results were reported for filtered samples due to laboratory or field contamination. Lead and manganese were also elevated above the screening values in the unfiltered sample from well E3-P11-M01. The lead level in well E3-P11-M01 dropped below the detection limit in filtered samples. The manganese dropped to less than half the unfiltered concentrations in filtered samples (to 212 μg/L in the August 1993 round and to 58.2 μg/L in the November round), but these concentration was still above the screening value of 50 μg/L (MA SMCL). The likely source of the metals found in unfiltered samples is suspended solids. No volatile or semivolatile organic compounds were detected in these wells.

Two surface water samples were taken on the runoff pathway from Site P11. Analysis of these samples indicated levels of arsenic (up to 1.98 μg/L, estimated), cadmium (1.46 μg/L), iron (2,800 μg/L) and lead (21.6 μg/L) above screening levels. The arsenic and iron concentrations, however, were below background levels, and are probably naturally occurring. Acetone (12.0 μg/L) was also found in this sample; however, given that the volatilization potential of acetone is high and that acetone was not found elsewhere at the site, the likely source of this detection is laboratory contamination.

A third surface water sample was taken at E3-P11-D03, which is located approximately 1600 feet downstream from Site P11, on Honey Brook, approximately 30 feet east of Puffer Pond Road. This sampling point is located on Honey Brook at a point that is downstream of Sites P4, P11, P13 and P26. Arsenic, manganese, and zinc were detected in the sample from E3-P11-D03 at concentrations above the background levels for stream waters at the Annex. Arsenic and iron were also detected at levels above surface water screening values. Arsenic (7.01 μg/L) was elevated above the screening value of 0.018 μg/L (MA/CWA WQC for human health for consumption of water and fish), and also the MA/CWA WQC for human health for consumption of fish only of 0.14 μg/L. However, this stream could not provide either edible-sized fish or drinking water. The arsenic level in this sample was well below the MA/CWA WQC for protection of aquatic life from chronic effects of 190 μg/L. Given that arsenic was not elevated above background in the surface water samples taken closer to the Site P11, the source of the arsenic, if not natural, is probably unrelated to Site P11.

In analysis of the three sediment sample taken in the downgradient run-off path to the south of Site P11, several metals were elevated above background levels, but only lead in one sample was above the sediment screening value. The lead (34.0 μg/g) concentration detected in the E3-P11-D01 sediment sample, which was taken in the wetland west of Site P11, was slightly above the lowest effect level for benthic organisms (31 μg/g, Ontario MOE LEL) used as the screening value. However, this level is below the NOAA ERL value of 35 μg/g and well below the NOAA ERM of 110 μg/g and this is not a site of permanent water.

PAHs were found at levels above sediment screening values in sediment sample E3-P11-D03, which was taken at a point just 30 feet east of Puffer Pond Road. PAH was not detected in the upstream Site P11 sediment samples, thus indicating the source is probably incomplete combustion products from passing automobiles, or perhaps past fires at the Annex.

The PAH compounds anthracene, benzo(a)anthracene, benzo(a) pyrene, chrysene, fluoranthene, phenanthrene, and pyrene were all found in this sample at levels above the NOAA ERL levels used as screening values. None of these compounds were found in a concentration above the NOAA ERM values. Benzo(b)fluoranthene was found at a concentration (1.40 $\mu g/g$) above the soil screening value of 0.7 $\mu g/g$ (MCP GW-1/S-1 and MCP GW-3/S-3). In sediment sampling at Site P13, the PAH compounds benzo(b) fluoranthene and fluoranthene were detected only at the sample taken just above where the drainage from Site P11/P13 enters Honey Brook but at lower levels than at the downstream sediment sample at E3-P11-D03, further indicating that Puffer Pond Road is the probable source of the PAH detections.

DDT and its degradation products DDD and DDE were found in sediments at concentrations above preliminary screening values. DDT (in two out of three samples), DDD (in two out of three samples), and DDE (in all three samples) were found in concentrations above the NOAA ERL for these compounds. The maximum detections of DDT (0.038 $\mu g/g$), DDD (0.100 $\mu g/g$), and DDE (0.079 $\mu g/g$) were all found at sample point E3-P11-D02 and were slightly above NYSDEC sediment quality criteria (0.064 $\mu g/g$ for both DDD and DDE) when adjusted for TOC content (63,800 $\mu g/g$ or 6.38 percent) of this sediment sample. Sampling point E3-P11-D02 is downgradient of Site P11/P13 and the northern part of the Taylor Drop Zone. Given that the DDT, DDD and DDE levels in the upstream sediment sample near Site P11 (E3-P11-D01) and downstream samples at E3-P13-D04, E3-P13-D05, and E3-P11-D03) had lower levels of these pesticides, the source is probably not Site P11, and may reflect spraying practices at Taylor Drop Zone (Site P26) or in general at the Annex. TPHC was detected in one of the three southern downstream samples (26.0 $\mu g/g$ at E3-P11-D01), at a level above the lowest effect level for TPHC of 2 $\mu g/g$ (Ontario MOE LEL) used as a screening value. This level probably reflects some low-level drainage of petroleum products from Site P11. TPHC was not detected in sediment samples taken further downstream from Site P11.

2.2.3.8 Conclusions and Recommendations

A remedial investigation is currently underway for Sites P11 and P13. Conclusions regarding the status of Site P11 and Site P13 will be included in the RI.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-15
Chemical Summary Report For Groundwater
Site: P11
Units: UGL

Test	Site ID	ATEC-1	ATEC-1	ATEC-1	ATEC-2	ATEC-2	ATEC-2
	Field Sample ID	MFP11A12	MXP11A11	MXP11A12	MFP11A22	MXP11A21	MXP11A22
	Sample Date	11/30/93	09/02/93	11/30/93	11/30/93	09/02/93	11/30/93
Test	Parameter						
TAL METAL	Aluminum	39.1 B	14000 @	19000 @	16.1 BJ	17000 @	2740 @
	Antimony	4.86 BJ	< 5.00	< 5.00	8.04 B@	< 5.00	< 5.00
	Arsenic	< 2.00	11.0 J	13.3	< 2.00	4.00 J	1.14 J
	Barium	6.16 J	66.3	81.8	11.8	40.7	22.6
	Beryllium	< 5.00	0.755 JK	0.299 J	< 5.00	0.999 JK	< 5.00
	Cadmium	< 5.00	2.06 J	< 5.00	1.88 J	< 5.00	< 5.00
	Calcium	3480	3910	4950	5070	3510	5080
	Chromium	< 10.0	25.1	23.4	< 10.0	29.5	4.86 J
	Cobalt	< 10.0	11.8	11.8	< 10.0	10.3	< 10.0
	Copper	< 10.0	19.3	24.8	< 10.0	23.7	3.37 J
	Iron	11.2 BJ	16000 K@	19000 @	< 25.0	16000 K@	2600 @
	Lead	< 5.00	5.90	7.78	< 5.00	7.68	1.12 BJ
	Magnesium	411 J	4480	4490	432 J	5430	1070
	Manganese	25.6	210 @	221 @	12.6 K	220 @	55.1 @
	Nickel	< 10.0	23.0	20.9	< 10.0	25.6	< 10.0
	Potassium	811 J	3860	4200	2240	6190	4490
	Sodium	6580 K	6270	7540 K	6160 K	7320	6950 K
	Vanadium	< 10.0	29.0	29.5	< 10.0	37.3	4.14 J
	Zinc	22.9 K	47.9 B	394	11.3 BJ	51.3 B	264
TCL BNA	Bis(2-ethylhexyl)phthalate		< 10.0	< 11.0		< 10.0	< 10.0
TPHC	Total Petroleum Hydrocarbons		< 2000	< 2000		< 2000	< 2000

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-15
Chemical Summary Report For Groundwater
Site: P11
Units: UGL

	Site ID	E3-P11-M01	E3-P11-M01	E3-P11-M01	E3-P11-M01	E3-P11-M01	E3-P11-M01
	Field Sample ID	MD1101F1	MD1101X1	MF1101X1	MFP11012	MX1101X1	MXP11012
	Sample Date	08/24/93	08/24/93	08/24/93	11/30/93	08/24/93	11/30/93
Test	Parameter						
TAL METAL	Aluminum	14.8 BJ	37000 @	14.7 BJ	24.9 BJ	31000 @	8520 @
	Antimony	2.46 BJ	< 5.00	4.11 BJ	7.30 B@	2.36 J	< 5.00
	Arsenic	< 2.00	8.49 J	< 2.00	< 2.00	5.91 J	2.83
	Barium	8.52 J	177	8.79 J	11.0	164	54.7
	Beryllium	< 5.00	1.71 J	< 5.00	< 5.00	1.51 J	< 5.00
	Cadmium	< 5.00	4.14 J	< 5.00	< 5.00	2.66 J	< 5.00
	Calcium	6120	11500	6140	8460	10600	13200
	Chromium	5.34 J	67.8	< 10.0	< 10.0	61.0	15.8
	Cobalt	< 10.0	28.4	4.62 J	< 10.0	24.3	4.03 J
	Copper	< 10.0	48.3	< 10.0	< 10.0	42.4	14.3
	Iron	22.3 BJ	41000 @	26.9 B	12.0 BJ	34000 @	9120 @
	Lead	< 5.00	17.1 @	< 5.00	< 5.00	13.8	3.98 KJ
	Magnesium	1060	12500	1090	897	10700	3480
	Manganese	212 @	621 @	212 @	58.2 @	556 @	156 @
	Nickel	< 10.0	70.6	< 10.0	< 10.0	52.5	17.1
	Potassium	3010	10900	3080	2210	9770	4310
	Sodium	3330	4700	3370	8920 K	4410	10100
	Vanadium	< 10.0	74.9	< 10.0	< 10.0	64.8	16.8
	Zinc	14.7 BJ	120 K	17.9 BJ	12.1 BJ	99.6 K	303
TCL BNA	Bis(2-ethylhexyl)phthalate						< 10.0
TPHC	Total Petroleum Hydrocarbons		< 2000			187 J	132 BJ

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-15
Chemical Summary Report For Groundwater
Site: P11
Units: UGL

	Site ID	EHA3	EHA3	OHM-P11-32	OHM-P11-32	OHM-P11-32	OHM-P11-32
	Field Sample ID	MFP11EH2	MXP11EH2	MF1132X1	MFP11322	MX1132X1	MXP11322
	Sample Date	11/30/93	11/30/93	08/25/93	11/30/93	08/25/93	11/30/93
Test	Parameter .						
TAL METAL	Aluminum	15.7 BJ	122 @	< 25.0	20.6 BJ	1200 @	1350 @
	Antimony	4.82 BJ	< 5.00	9.06 B@	< 5.00	< 5.00	< 5.00
	Arsenic	< 2.00	3.54	< 2.00	< 2.00	2.13 J	2.08
	Barium	< 10.0	< 10.0	< 10.0	< 10.0	9.06 J	12.3
	Beryllium	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
	Calcium	8360	8290	5620	5200	6070	5480
	Chromium	< 10.0	< 10.0	< 10.0	< 10.0	5.83 J	< 10.0
	Cobalt	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
	Copper	4.21 J	< 10.0	< 10.0	4.08 J	< 10.0	6.18 J
	Iron	17.0 BJ	745 @	< 25.0	13.3 BJ	1330 @	1630 @
	Lead	< 5.00	1.45 BJ	< 5.00	< 5.00	4.90 J	3.01 BJ
	Magnesium	1090	1180	281 KJ	294 J	583	605
	Manganese	9.19 B	14.0	3.09 BJ	2.58 BJ	15.9	17.2
	Nickel	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
	Potassium	4560	4280	2720	2390	2580	3120
	Sodium	17400	16100	2730	2550 B	2240	2950 B
	Vanadium	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
	Zinc	12.6 BJ	224	8.95 BJ	9.33 BJ	26.5 B	216
TCL BNA	Bis(2-ethylhexyl)phthalate		5.60 J				< 10.0
TPHC	Total Petroleum Hydrocarbons		< 2000				< 2000

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-15
Chemical Summary Report For Groundwater
Site: P11
Units: UGL

	Site ID	OHM-P11-33	OHM-P11-33	OHM-P11-33	OHM-P11-33		
	Field Sample ID	MF1133X1	MFP11332	MX1133X1	MXP11332		
	Sample Date	08/25/93	11/30/93	08/25/93	11/30/93		
Test	Parameter						
TAL METAL	Aluminum	66.7 B@	106 B@	1180 @	553 @		
	Antimony	3.59 BJ	< 5.00	< 5.00	< 5.00		
	Arsenic	6.50	2.60	5.73 J	2.83		
	Barium	< 10.0	< 10.0	7.13 J	< 10.0		
	Beryllium	< 5.00	< 5.00	0.414 J	< 5.00		
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00		
	Calcium	29100	15300	28400	15200		
	Chromium	< 10.0	< 10.0	5.04 J	< 10.0		
	Cobalt	< 10.0	< 10.0	11.8	< 10.0		
	Copper	2.26 J	< 10.0	5.88 J	3.57 J		
	Iron	< 25.0	14.9 BJ	918 @	385 @		
	Lead	< 5.00	< 5.00	< 5.00	1.81 BJ		
	Magnesium	368 J	448 J	661	510		
	Manganese	1.47 BJ	5.69 B	16.0 K	9.38		
	Nickel	< 10.0	< 10.0	< 10.0	< 10.0		
	Potassium	2020	2050	2350	1930		
	Sodium	3610	2860 B	3220	3680 B		
	Vanadium	11.1	< 10.0	17.2	5.41 J		
	Zinc	8.41 BJ	5.39 BJ	21.2 B	180		
TCL BNA	Bis(2-ethylhexyl)phthalate				< 12.0		
TPHC	Total Petroleum Hydrocarbons				< 2000		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 2-16
Chemical Summary Report For Subsurface Soils
Site: P11
Units: UGG

	Site ID	E3-P11-M01					
	Field Sample ID	BX1101X1					
	Sample Date	08/03/93					
Test	Parameter Depth	0.0 ft.					
TOC	Total Organic Carbon	4560					

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 2-17
Chemical Summary Report For Surface Waters
Site: P11
Units: UGL

	Site ID	E3-P11-D01	E3-P11-D01	E3-P11-D02	E3-P11-D03	E3-P11-D04	E3-P11-D04
	Field Sample ID	WDP11012	WXP11012	WXP11022	WXP11031	WXP11042	WXP11043
	Sample Date	12/01/93	12/01/93	12/01/93	09/15/93	12/02/93	4/26/94
Test	Parameter .						
TAL METAL	Aluminum	4090 J!	2910 J!	342 J	235 J	22000 J!	73.0
	Arsenic	1.57 J@	1.94 J@	1.98 J@	7.01 !@	90.8 !@	<2.00
	Barium	78.3 J!	52.3 J!	14.2 J!	7.86 J	512 J!	7.85 J!
	Beryllium	0.288 J	0.217 J	< 5.00	< 5.00	3.78 J	0.268 J!
	Cadmium	< 5.00	< 5.00	1.46 J#	< 5.00	4.23 J#	<5.00
	Calcium	8430	7210	11200 !	4470	140000 !	10500 !
	Chromium	3.89 J!	< 10.0	< 10.0	< 10.0 K	46.3 !	<10.0
	Cobalt	3.10 J	3.18 J	< 10.0	2.76 J	110 !	<10.0
	Copper	10.5 !	7.22 J	< 10.0	< 10.0	196 !#	4.03 J!
	Iron	2800 J#	1830 J#	220 J	1580 #	130000 J!#	330
	Lead	21.6 !#	13.0 !#	2.16 BJ	1.33 J	330 !#	1.24 J
	Magnesium	1710	1640	1960 !	840	12300 !	2310 !
	Manganese	544 !	515 !	71.4	165 !	9500 !	24.5
	Mercury	< 0.200	< 0.200	< 0.200	< 0.200	0.244 @#	<0.200
	Nickel	< 10.0	< 10.0	< 10.0	< 10.0	260 !#	<10.0
	Potassium	1210 B	1070 B	1370 B	885 J	4980 K!	2120 !
	Selenium	< 2.00	< 2.00	< 2.00	< 2.00	6.78 !#	<2.00
	Silver	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	2.31 !
	Sodium	3290 B	3250 B	5420 B	3490	8130 K	9340
	Vanadium	10.1 !	5.64 J!	< 10.0	< 10.0	88.6 !	2.84 J
	Zinc	82.7 !	65.7 !	35.0 !	30.7 !	940 !#	49.8 !
TCL VOA	Acetone	< 10.0	12.0	< 10.0	< 10.0	< 10.0	
TPHC	Total Petroleum Hydrocarbons						<2000
WQP	Total Suspended Solids						5.00

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 2-18
Chemical Summary Report For Sediments
Site: P11
Units: UGG

	Site ID	E3-P11-D01	E3-P11-D02	E3-P11-D02	E3-P11-D03	E3-P11-D04	E3-P11-D04
	Field Sample ID	DX1101X1	DX1102X1	DX1102X1	DXP11031	DXP11042	DXP11043
	Sample Date	08/03/93	08/03/93	08/30/93	09/15/93	12/02/93	4/26/94
Test	Parameter .						
TAL METAL	Aluminum	8700 !	6300 !		2880	3730	2490
	Antimony	<0.500	<0.500		<0.500	<0.500	1.01 J!
	Arsenic	2.81 !	2.38 !		4.84 !	11.6 !#	2.35 !
	Barium	19.5	25.7 !		6.20 J	36.4 !	18.4
	Beryllium	0.205 J!	0.294 J!		0.146 JL	0.282 J!	0.201 J!
	Calcium	< 500	1610 !		343 J	10500 !	2900
	Chromium	2.87 J	6.62		5.20	7.77 J	3.72 J
	Cobalt	2.23	2.34		4.06 !	5.18 J!	2.15
	Copper	8.13 !	8.31 !		2.50 L	5.65	5.99
	Iron	6900	3500		6990	4200	3390
	Lead	34.0 !#	31.0 !		7.17 !	5.13 !	33.0 !#
	Magnesium	409 J	731 J		88700 !	1110 J	470 J
	Manganese	14.4	30.9		148 !	56.0	31.7 !
	Nickel	4.28	6.33 !		6.12 !	26.0 !#	5.97
	Potassium	169 BJ	363 KJ		205 BJ	< 200	<200
	Selenium	0.572 !	0.724 !		< 0.200 L	3.17 !	1.08 L!
	Silver	< 0.200	< 0.200		< 0.200	1.89 #	<0.200
	Vanadium	10.7	10.3		7.16	9.79 J	2.94 J
	Zinc	12.6	23.2 !		17.6 J	21.8 !	49.9 !
TCL BNA	4H3MBA				0.093		
	Anthracene	< 2.00	< 0.330		0.210 J#	< 0.330	
	Benzo(a)anthracene	< 2.00	< 0.330		1.20 @#	< 0.330	
	Benzo(a)pyrene	< 2.00	< 0.330		0.870 @#	< 0.330	
	Benzo(b)fluoranthene	< 2.00	< 0.330		1.40 @	< 0.330	
	Benzo(ghi)perylene	< 2.00	< 0.330		0.300 J	< 0.330	
	Benzo(k)fluoranthene	< 2.00	< 0.330		0.550	< 0.330	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 2-18
Chemical Summary Report For Sediments
Site: P11
Units: UGG

	Site ID	E3-P11-D01	E3-P11-D02	E3-P11-D02	E3-P11-D03	E3-P11-D04	E3-P11-D04
	Field Sample ID	DX1101X1	DX1102X1	DX1102X1	DXP11031	DXP11042	DXP11043
	Sample Date	08/03/93	08/03/93	08/30/93	09/15/93	12/02/93	4/26/94
Test	Parameter .						
TCL BNA	Chrysene	< 2.00	< 0.330		1.00 @#	< 0.330	
	Dibenzo(a,h)anthracene	< 2.00	< 0.330		0.150 J	< 0.330	
	Fluoranthene	< 2.00	< 0.330		1.80 #	< 0.33[illegible]	
	Indeno(1,2,3-cd)pyrene	< 2.00	< 0.330		0.400 J	< 0.[illegible]	
	Phenanthrene	< 2.00	< 0.330		0.510 #	< 0.330	
	Pyrene	< 2.00	< 0.330		1.40 #	< 0.330	
TCL Pest	P,P-DDD	0.010 C	0.100 C#		0.004 U#	< 0.020	
	P,P-DDE	0.022 C#	0.079 C#		0.015 C#	< 0.020	
	P,P-DDT	< 0.010	0.038 JC#		0.010 CK#	< 0.020	
	alpha-BHC	< 0.005	< 0.010		0.001 JC	< 0.010	
TOC	Total Organic Carbon	143000	63800		12000		107000
TPHC	Total Petroleum Hydrocarbon	26.0 J!#	< 20.0		< 20.0	106 !#	<20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

2.2.4 Site P13 — Massachusetts Fire Fighting Academy (MFFA)

Site P13 was identified as a possible concern in a Fort Devens memo in 1990. It was suspected that potential contamination could exist at Site P13 as a direct result of the underground storage tanks (USTs), aboveground storage tanks (ASTs), and fire training activities associated with the site area. Figure 2-5 provides a site map.

2.2.4.1 Site Location

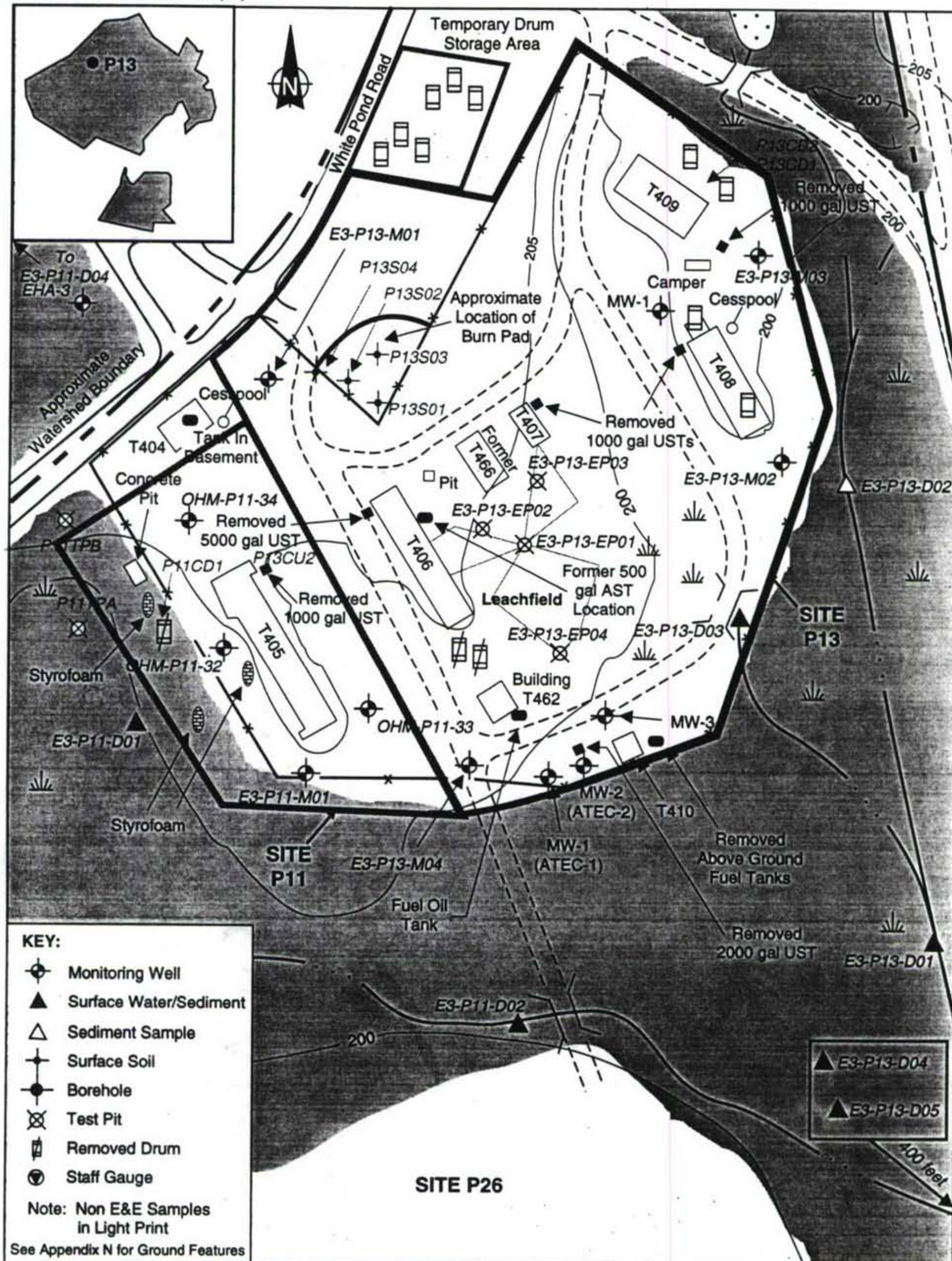
Located in the western part of the Annex and immediately south of the intersection of White Pond Road and Patrol Road, Site P13 is surrounded by a wire fence. Access to the site is from White Pond Road. Within the fence there are many buildings including Building T405 (the barricade building defined in this report as part of Site P11), Building T406 (the heat plant and shops), Building T407 (site of miscellaneous operations), Building T408 (a surveillance building), and Building T409 (which was used for packaging and assembly). Paved roads and paths lead up to the buildings. Near the entrance to Site P13 is a large concrete covered area which looks like a parking lot. This area is currently referred to as the "Temporary Drum Storage Area." Drums from Site P13 and other sites at the Annex are brought here and stored on a plastic liner prior to final disposal. Currently, approximately 50 drums, including drums with well cuttings, are stored. Also at Site P13 are several concrete and metal structures, such as metal tanks and cement pads. Other drums still remain scattered in proximity to the buildings or within the buildings themselves. One drum is inside Building T408, another can be seen through a window of an underground room on the side of Building T408, and two empty drums lie behind Building T409.

2.2.4.2 Physical Characteristics

Site P13 is located in an area of glacial outwash sand and gravel, lying between two hills of till, a drumlin to the east and a ground moraine with bedrock outcrops to the west (Hansen 1956). Surface elevations at Site P13 range from 200 to 208 feet AMSL. Average groundwater elevations at the site range from 195 to 198 feet AMSL.

Four monitoring wells (E3-P13-M01, E3-P13-M02, E3-P13-M03, and E3-P13-M04) were installed by E & E in 1993. At the boring for well E3-P13-M01, outwash material consisting of a poorly sorted sand, silt, and gravel mixture extended through the total depth of 23 feet. The presence of finer grained material and some clay was noted from 19 to 23 feet BGS possibly indicating gradation to till. Grain size and Atterberg limits analyses performed on soil samples collected from the 14 to 16 foot and 19 to 21 foot intervals at E3-P13-M01 were both identified as non-plastic, poorly graded sand with silt. Borings at locations E3-P13-M02, E3-P13-M03, and E3-P13-M04 encountered poorly sorted outwash material from 0 to 9 feet BGS and a dense, finer grained silty sand, possibly indicative of lake sediments from 9 to 18 feet. Geotechnical analyses performed on samples collected at these wells identified non-plastic poorly graded sands in the 4 to 6 foot and the 14 to 16 foot intervals at E3-P13-M02 and the 4 to 6 foot interval at E3-P13-M03. A soil sample collected from the 14 to 16 foot interval at E3-P13-M03 was classified as sandy silt, and a soil sample collected from the 9 to 11 foot interval at E3-P13-M04 as sandy silt of low

11: SUDBURY\UC6_P11B.CDR (P2)



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 2-5 MAP OF SITE P13, MASSACHUSETTS FIRE FIGHTING ACADEMY

plasticity (liquid limit less than 35). Additional geotechnical analyses of five sediment samples collected in association with Site P13 yielded soil classifications of non-plastic, poorly graded to well-graded sands, with silt. One sediment sample, E3-P13-D01, was identified as organic silt with extremely high plasticity (liquid limit more than 90). Appendix D contains a complete summary of geotechnical results. Bedrock was not encountered during subsurface explorations but is projected to be Gospel Hill Gneiss (Hansen 1956). A layer of till is expected to lie between outwash material and bedrock. The seismic survey interpreted an approximate depth to bedrock, which varies between approximately 65 to 70 feet under White Pond Road northeast of the site entrance to perhaps as little as 30 feet along the southern site boundary (see Figure 3-5, Appendix E). The complexities of the site, with at least four different seismicly different layers under it, unsaturated outwash, saturated outwash, till, and bedrock makes depths to bedrock somewhat speculative. Depth to bedrock was not confirmed at any borehole or well location. The top of till above the bedrock appears to be more probably the controlling factor in groundwater flow, but this horizon could not be picked out with sufficient assurance to be mapped.

Slug tests conducted by E & E in 1993 at the four monitoring wells show low aquifer transmissivities (T) ranging from 21.03 feet^2 per day at E3-P13-M01 to 216.25 feet^2 per day at E3-P13-M02. Aquifer thicknesses for all calculations were equal to the length of the water column in each well. Transmissivities were calculated as follows:

$$T = Kb$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer Thickness (feet)

Well	K	b	T
E3-P13-M01	3.535	5.95	21.03
E3-P13-M02	15.25	14.18	216.25
E3-P13-M03	4.160	10.99	45.72
E3-P13-M04	7.406	11.43	84.65

Appendix G contains complete slug test data and interpretation. These numbers are consistent with other observed transmissivities in similar areas throughout the watershed; however, conservative aquifer thickness presumptions may yield shortly lower than actual transmissivities. These T-values are those of a low yield aquifer as defined in 310 CMR 40.0006.

The boundary between Watershed 1B (Lower Taylor Brook) and Watershed 3 (Lower Assabet River) is defined by White Pond Road, northwest of Site P13. Surface water flows east and south from the site to adjacent wetlands, which are in turn drained by Honey Brook.

As at Site P11, an apparent groundwater divide runs east to west across Site P13 through Buildings T406 and T408. Groundwater south of this divide flows south and southeast to the adjacent wetland and to Honey Brook. Groundwater at the north end of Site P13 flows northwest under White Pond Road exiting Watershed 1B and joining groundwater flow in Watershed 3. Within Watershed 3, groundwater is discharged to a spring or seep and wetland area from which an unnamed stream drains north to the Assabet River. The spring or seep is approximately 500 feet north of the entrance to Site P13 from White Pond Road.

2.2.4.3 Ecological Characterization

Sites P11 and P13 are adjacent sites; consequently, the ecologies have been discussed together. Please refer to the ecological characterization provided in Section 2.2.3.3.

2.2.4.4 Site History

Site P13 has been used extensively by varying units and for field test activities, starting in 1952 and continuing until as late as 1988. The area was the location of a farm prior to Army use, and some of the buildings were converted from farm use. Probable and confirmed uses of Site P13 have included ordnance research and development, laboratory research on foamed plastics, organic chemicals, flame testing, meteorological projects, and insecticide and rodenticide research (all within Building T405, part of Site P11), and training of Massachusetts State Police, Air National Guard, and MFFA units. Building T405 was the center of much of the laboratory research conducted at Site P13 between 1957 and 1982.

Many of the buildings at Site P13 were built in 1952. A 1955 map identifies the site as a "Restricted Area," with the following buildings: T402-T409, T419, T461, and T462 present. Building T405 was identified as the "barricade building." Building T406 was used for a "power plant" and machine shop. Building T407 was for "misc" (miscellaneous) use, probably a lavatory. Building T408 was identified as the "surveil" building (presumably surveillance of some kind). Building T409 was identified as the "asses & pack" building (presumably assembly and packaging of material). Building T462 was only identified as "Building D." These buildings are probably the location ordnance research and development in the years between 1952 and 1957. A 1958 reference to the "Exclusion Area" at Site P13 noted a plot plan from Arthur D. Little, Inc., one of the contractors identified as using the Maynard Ordnance Test Station for research and development activities for the Army Chief of Ordnance. The 1978 Natick Analysis of Existing Facilities/Environmental Assessment Report noted that the "troop area of about 48 acres, partially enclosed by a security fence...was formerly the location of Classified Ordnance Research and Development activities."

In 1958, the buildings at Site P13 were converted for use by the Quartermaster Research and Engineering Center and its various divisions. The area around Site P13, including Sites A8 and A9 became known as the "Troop Area." A July 1959 memo from the Quartermaster Research and Engineering Center noted the following building use: Building T403 for storage and as a base post exchange (PX), Building T406 as a kitchen and mess hall, Building T407 as a latrine and shower, Building T408 as a barracks, Building T409 as a barracks and recreation hall, Building T419 as a latrine and shower, Building T461 as

unassigned with designation "print shop," and Building T462 as a supply building. In 1960, Building T466 was built as a general storehouse. Some of these buildings continued to be used for these same purposes up to site closure. By 1962, Building T410, one of the old farm buildings, had become part of a gas station with gas pumps located in front of it. Building T462 was converted into a fire station, Building T461 was used for storage, while Building T466 was apparently converted into a barracks. By 1964, Building T419 had been designated as a first aid building. Prior to 1966, Building T466 was used for research and development by the Air Drop Engineering Division at Natick. Building T419 was demolished in 1966.

Starting in 1969, the "Troop Area" began to be used to house outside training units. The Massachusetts State Police obtained a lease to use Buildings T406, T407, T408, and T409 for police training purposes starting in May 1969. The MFFA may have begun some use of Site P13 around 1971. The Massachusetts Army National Guard was permitted a one-year lease to use Buildings T406, T407, T408, and T409 for training purposes in 1971. After 1971, the Army National Guard was also permitted to use Building T405. According to real property records, the Massachusetts Air National Guard had a permit to use Buildings T406, T407, T408, and T409 and the surrounding 304 acres from January 1973 to January 1978 for training exercises and storage of tactical weather station equipment. The Massachusetts Army National Guard used these same buildings for storage in 1978, in addition to utilizing the gas pump at Building T410. The USAF obtained a permit to use Buildings T406, T407, T408, and T409 and the surrounding 304 acres for use by the Air National Guard in 1978, and training continued at least until 1980. Building T404 was leased to the USAF for use as office space for scientists working on meteorological research projects. Building T462 may have also been used by the USAF as an equipment machine shop.

The CEMEL of Natick Laboratories used Building T406 for fully instrumented mannequin studies in 1975, and was using Buildings T401, T402, T405, T410, and T462 in 1977.

The MFFA used Site P13 at various times beginning in 1971. According to 1971 property records, MFFA used the parking area in front of Buildings T406 and T407 for firetruck driver training purposes and waterholes No. 35 and No. 36 for pumping operations. According to an interview with MFFA personnel (Interview 1991E), MFFA has used P13 on a limited basis since 1982. The MFFA used Building T406 for a classroom and Buildings T461 and T462 for storage of equipment. Some kind of building use continued apparently through 1988, when the last recorded lease allowing MFFA use of Buildings T406 and T409 expired. Use of the parking area in front of Site P13, where car fire and flammable liquid fire training was conducted, continued at least into the fall of 1991. Car fire training was conducted with the gasoline tanks removed and straw as the combustible material. Flammable liquid fire training was conducted in a pan apparatus using fire extinguishers. A 500-gallon fuel storage trailer was used in connection with the pan fires. According to the MFFA, flammable liquid training was conducted approximately 12 times and car training five times a year. Site P13 was reportedly not used for chemical fire training or storage.

Poor housekeeping practices of hazardous material by the MFFA were noted by Fort Devens personnel in a 1986 memo (Fort Devens 1986). The 500-gallon fuel storage trailer

and drip pans were noted as having dead grass surrounding them. The burning pan was filled to near capacity with fuel mixed with water. Numerous stains were observed around the pan and dead grass was observed downgrade from the pan. By 1991, the pan assembly had a plywood cover to keep out rainwater, and a second pan was located below the burn pan to contain spills.

Real Property records indicate that five underground storage tanks were located at the buildings in Site P13. Buildings T407, T408, and T409 all had 1,000-gallon, single-wall, steel USTs for No. 2 Fuel Oil. Building T406 had a 5,000-gallon steel UST for No. 2 Fuel Oil. Building T410 had a 2,000-gallon steel UST for gasoline and several aboveground fuel tanks as well. Real property records also indicate that Building T407 had two septic tanks, and Building T408 a single cesspool. Geophysical investigations and exploratory test pits were completed at Site P13 and described under "Leach Field Identification" in Section 2.4.4.6, Field Work Performed. The investigations provided evidence of the septic systems and associated distribution system.

2.2.4.5 Results of Previous Investigations

Results of Phase I investigations carried out at Site P13 are described in Section 7.22 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). A site investigation was performed by OHM and has included a soil-gas survey, a geophysical study, surface soil sampling, drum removal and confirmatory soil sampling, and confirmatory soil sampling after the removal of USTs and ASTs.

The soil-gas survey conducted in 1991 revealed ethylbenzenes (2.2 μg/L) and xylenes (3.2 μg/L) in a single sample (PB-101). PID volatiles (up to a level of 273 μg/L) were detected at 13 locations scattered across the site at location P13-101 (OHM 1992).

In 1992, OHM collected surface soil samples to characterize the extent of surface contamination at P13. DDT was found in every soil sample with a maximum of 0.6 μg/g, which exceeded the levels of DDT in background soils. Heptachlor epoxide (0.16 μg/g), and β-endosulfan (0.29 μg/g) were found in sample P13SO1. This sample also contained PAHs, and elevated levels of the following metals as compared to background soils: barium (252 μg/g), cadmium (14.2 μg/g), and zinc (910 μg/g). All soil samples contained some lead (up to a level of 160 μg/g), which exceeded leads in background soils.

In October 1992, OHM collected eight samples (P13CA1 through P13CA8) near four 500-gallon ASTs. All tanks except for one behind Building T462 were subsequently removed by Fort Devens personnel. Pesticides, other than DDT, including α-chlordane (0.233 μg/g), γ-chlordane (0.301 μg/g), heptachlor (0.015 μg/g), epoxide (0.060 μg/g), dieldrin (0.03 μg/g), and β-endosulfan (0.138 μg/g) were identified in the AST confirmation samples from Building T462 (P13CA5 and P13CA8) and Building T406 (P13CA7 and P13CA8). The PCB Aroclor 1254 (0.434 μg/g) was found in both AST samples from Building T410 in P13CD3. Traces of solvents such as MEK (0.004 μg/g), 1,1,1-trichloroethene (0.002 μg/g), trichlorofluorethene (Freon-11) (0.01 μg/g) were present at Building T402 and T406. Unknown BNAs indicating hydrocarbon contamination were detected at Building T462

(P13CD5 and P13CD6) and metals were found at elevated concentrations compared to background soils at Building T406; maximum concentrations were copper (526 μg/g), nickel (28.3 μg/g), vanadium (114.4 μg/g), mercury (0.411 μg/g), and zinc (311 μg/g).

Removals

Five USTs at Site P13 were identified during the geophysical surveys. Three 1,000-gallon USTs associated with Buildings T407, T408, and T409 were excavated and removed by ATEC in May 1992 (ATEC 1993). A 2,000-gallon tank associated with Building T410 and a 5,000-gallon tank near Building T406 were also removed.

Upon excavation of the 1,000 gallon UST near Building T407, the tank was observed to be in good condition. Laboratory analysis of two soil samples detected TPHC (10 ppm) in LSS-1, and TPHC (19 ppm) in LSS-2. NDIR analysis of one sample (SS-9) from the bottom of the excavation also showed TPHC (287.2 ppm). PID analysis of the nine other soil samples revealed TOV concentrations ranging from 0.0 ppm to 9.4 ppm while NDIR results ranged from 3.2 ppm to 37.3 ppm of TPH. The excavation was backfilled with native soil obtained during tank removal. Due to the elevated NDIR reading of TPHC (287.2 ppm) at sample SS-9 at the bottom of the excavation, ATEC subsequently recommended the installation of groundwater monitoring wells and soil borings to determine the extent of vertical and horizontal contamination (ATEC 1993).

The 1,000-gallon UST near Building T408 was removed in good condition. Laboratory analysis of two samples detected TPHC (23 ppm) in one sample, and TPHC (56 ppm) in the other. No detectable levels of VOCs were found during laboratory analysis of additional samples taken from walls of the excavation. Analysis of another sample showed TPHC (45 ppm), zinc (0.11 ppm), and a pH (5.3). Approximately 28.82 tons of contaminated soil was removed and disposed of by Trimount Bituminous Products. In October 1992, a groundwater monitoring well, MW-1, was installed to assess soil and groundwater conditions in the vicinity of the tank. TPHC was not detected in groundwater. ATEC did not recommend any immediate remedial or investigative action (ATEC 1993). Periodic sampling of the well, however, was recommended.

The 1,000-gallon UST at Building T409 was removed in good condition. Laboratory analysis of two samples from the excavation showed TPH (137 ppm) in one sample, and TPH (61 ppm) in the other. Analysis of groundwater encountered during the excavation revealed no detectable TPH concentrations. Analytical results of confirmation samples from the excavation showed TPHC (11 to 15 ppm). Metal concentrations were lead (0.5 ppm), copper (0.09 ppm), nickel (0.18 ppm), and zinc (0.4 ppm). The excavation was backfilled with sand. ATEC recommended performing soil borings and installing groundwater monitoring wells (ATEC 1993).

Laboratory analysis of soil samples taken from the excavation of the 5,000-gallon UST at Building T406 did not detect any TPH. No pesticides were detected in an additional sample, P13CD1, collected by OHM from the excavation. However, a trace of toluene was found to be present. Tank contents were also analyzed revealing a semivolatiles range of

Di-n-butylphthalate (2,750 ppm) to 2-methylnaphthalene (52,700 ppm). Backfill consisted of native soil, which had been excavated to free the tank. ATEC recommended no further investigation (ATEC 1993).

During the excavation of the 2,000-gallon UST at Building T410, the tank was observed to be corroded and soil was visibly stained. Laboratory analysis of two samples showed TPHC (12 ppm; 24 ppm). In October 1992, 140.4 tons of gasoline-contaminated soil were removed and disposed of by Bardon Trimount Bituminous Products, Shrewsbury, Massachusetts. Three groundwater monitoring wells were also installed (MW1, MW2, and MW3). No TOVs were detected using a PID to screen water samples; a range of TPHC (15.9 to 322.1 ppm) was detected using a Non-Dispersive Infra-Red (NDIR) analyses. The excavation was backfilled with sand. No further investigation was recommended by ATEC (ATEC 1993).

Several empty drums were moved from Site P13 to the Temporary Drum Storage Area. Three drum confirmation samples were taken. The following were found to be slightly elevated when compared to background soil samples: a maximum of DDT (0.6 μg/g) in P13CD2, DDE (0.4 μg/g) in P13CD2, arsenic (8.7 μg/g) in P13CD3, cadmium (0.99 μg/g) in P13CD2, and mercury (0.11 μg/g) in P13CD3.

2.2.4.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of geotechnical samples, were analyzed for TCL organics, TAL metals, TPHC, and herbicides on the Drinking Water Standard. A summary of Phase II Sampling Activities at Site P13 is provided as Table 2-19.

Geophysical Investigations

EM31 and magnetometer surveys were conducted in the cleared areas surrounding Buildings T406, T407, and T462, to identify any existing septic tanks or leach fields and their approximate locations. Background research was conducted prior to the geophysical investigations and blueprint designs for the buildings' planned sewer system were obtained to assist the geophysicists during the surveys. The surveys identified several locations that would be further investigated by exploratory test pits excavated with a backhoe. The approximate layout of the septic system and leach field was identified and no unusual anomalies were noted (see Figure 3-7, Appendix E). The detailed results of the geophysical investigations and the approximate locations of any anomalies can be found in the geophysical investigations report in Appendix E.

Table 2-19

PHASE II SAMPLING EFFORTS AT SITE P13 — MASSACHUSETTS FIRE FIGHTING ACADEMY

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	8	08/24/93 08/25/93 11/29/93 11/29/93	Samples were collected to characterize groundwater quality and the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	4	08/02/93 08/03/93	Samples were collected from the screened interval of each well and sent for TOC analysis to characterize nature of subsurface soils and their impact upon contaminant migration.
	4	08/02/93 08/03/93	Samples collected from the saturated zone in each well and sent for grain size and Atterberg limits analyses to provide data on nature of subsurface soils and their impact upon groundwater hydraulic conductivity.
Surface Water	4	08/02/93 08/03/93 12/01/93	Samples were collected to investigate the impact of past site activities on the streams in the area and the potential for the streams and the wetland areas to act as future contaminant sources.
Sediment	5	08/02/93 08/03/93 12/01/93	See Surface Water sampling rationale.
	5	08/02/93 08/03/93 12/01/93	Samples were collected for TOC analysis.
	5	08/02/93 08/03/93 12/01/93	Geotechnical samples were collected at location E3-P13-D01 through D05 to characterize the nature of surface soils.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

To characterize groundwater quality at Site P13, E & E installed, developed, and sampled four shallow overburden monitoring wells (E3-P13-M01 through E3-P13-M04). Both filtered and unfiltered samples were collected from each well. The well locations were chosen based upon the results of a seismic survey which was conducted at the site to identify the underlying bedrock or till contours which were expected to control groundwater flow. The seismic survey results and the geology of the area are more completely described in the Watershed 1B geology description in Section 2.1.1. Each of the four wells was sampled during both groundwater sampling events in August and November 1993.

Well E3-P13-M01 is located in the western portion of the site, approximately 50 feet south of the entrance road to the buildings. The well is screened across the water table at an interval 9 to 19 feet BGS. Well E3-P13-M02 is located in the eastern corner of the site, approximately 40 feet southeast of Building T408. The well was completed adjacent to the wetlands which border the site along its northern and eastern edges. It was screened across the water table at an interval 8 to 18 feet BGS. Well E3-P13-M03 is located along the northeastern edge of the site, upgradient of Buildings T408 and T409 and downgradient of the wetlands which lie to the north. The well is screened across the water table at an interval 8 to 18 feet BGS. The fourth newly installed well (E3-P13-M04) is located in the southeast corner of the site, approximately 100 feet southeast of Building T462. The well was completed downgradient of Buildings T406 and T462, and lies at the intersection of the road which runs near the perimeter of the site and the overgrown access road which connects P26 (Taylor Drop Zone) to Sites P11 and P13. Well E3-P13-M04 is screened across the water table at an interval 8.6 to 18.6 feet BGS.

Subsurface Soil Sampling

During monitoring well installation geotechnical samples were collected from the saturated zone in each of the four wells and sent for grain size and Atterberg limits analyses. In addition, samples were collected from each of the wells near the screened intervals and analyzed for TOC content. These samples provide data to assess the nature of the subsurface soils in the area and their potential effect on contaminant migration in the groundwater pathway.

Surface Water and Sediment Sampling

A total of four surface water and five sediment samples were collected from wetlands and streams which lie adjacent to Site P13, to assess the nature of contamination in the surface water pathway and the potential for the pathway to act as a source of future contaminant migration. The disparity between the total number of sediment samples (5) and surface water samples (4) is due to the relatively dry summer and the inability to collect a surface water sample from one of the five sediment sampling functions.

One of the sampling locations (E3-P13-D03) was chosen to characterize water quality in an intermittent stream which carries surface runoff from the southeastern corner of Site P13. The stream or runoff channel originates near the bend in the road between Buildings T462 and T408, approximately 250 feet south of monitoring well E3-P13-M02. A second sampling location (E3-P13-D02) was chosen to characterize any contamination in the wetlands and intermittent streambed which lie along the eastern edge of Site P13. The location is south of the small pond which lies near the intersection of White Pond Road and Puffer Road. The wetlands lie between Puffer Road and the northern and eastern edges of Site P13, and act as the main recipient of surface run-off from the northeastern portion of the site. Sample location E3-P13-D01 lies at the convergence of the two previously sampled intermittent streams (E3-P13-D02 and E3-P13-D03). Sample locations E3-P13-D04 and E3-P13-D05 are both located downstream of the three other Site P13 locations and lie in the

larger intermittent stream which carries runoff from Sites P11 and P13, alongside the eastern edge of Taylor Drop Zone (Site P26), and ultimately to Honey Brook to the south.

Due to the relatively dry summer, surface water samples could not be collected at four of the five locations during the August 1993 sampling event. Sampling location E3-P13-D01 was the only point where both surface water and sediment samples were collected. To complete the original work plan sampling requirements, the missed surface water samples corresponding to locations E3-P13-D02 through E3-P13-D05 were collected during the wetter December 1993 sampling event. In addition, due to laboratory and field coordination problems, sediment samples were collected from all five locations in December and analyzed for herbicides.

All sediment samples collected were analyzed for TOC. Furthermore, geotechnical samples were collected from the surface water and sediment sampling locations and sent for grain size and Atterberg limits analyses. The samples provide data to characterize the stream sediments, their impact upon the surface water pathway, and the potential for contaminant migration.

Leach Field Identification

EM31 and GPR studies were conducted to assist in the identification of the septic field associated with Buildings T406 and T407. Three exploratory pits were excavated in the central area of Site P13 to trace the septic lines from these two buildings. The septic lines from the two buildings meet at a junction box approximately 100 feet northeast of Building T406 and 75 feet directly south of Building T407. The two buildings both utilized a septic field which is located below the junction box and is oriented in a southeasterly direction. The field extends approximately 225 feet southeast of the junction box. Drainage from the field enters a small wetland which drains under a dirt road to the southeast. No visible signs of contamination or odors were observed during the exploratory pit excavation.

2.2.4.7 Nature and Extent of Contamination

Northern Groundwater Drainage from Site P13

Analysis of sampling from well E3-P13-M03, which is upgradient of Buildings 408 and 409 in the northern groundwater drainage, indicated levels of aluminum, iron, manganese, and sodium in the unfiltered samples above groundwater screening values. The aluminum, iron, and manganese concentrations in unfiltered samples exceeded the Massachusetts SMCLs, while the sodium level (in the September 1993 round only) was above the EPA Drinking Water Health Advisory Level of 20,000 μg/L. The concentrations of manganese (172 μg/L) and sodium (43,700 μg/L) found in the filtered samples were also elevated above screening values. These concentrations probably reflect naturally high manganese levels seen elsewhere at the Annex, and the use of road salt resulting in elevated sodium. No organic compounds were detected in sampling at well E3-P13-M03, except TPHCs (332 μg/L) which is well below the groundwater screening value of 1,000 μg/L (MCP GW-1 groundwater value). A summary of detections above preliminary screening levels is

provided in Table 2-20. Chemical summary tables are included at the end of the discussions of this site as Tables 2-21, 2-22, 2-23, and 2-24.

Analysis of sampling from well E3-P13-M01, which is downgradient in the northern groundwater drainage from the site, indicated elevated levels of aluminum, iron, lead, manganese, and sodium in unfiltered samples and elevated levels of manganese, and sodium in the filtered samples. The levels of aluminum, iron, and manganese in the unfiltered samples were above the Massachusetts SMCLs for these compounds. The level of lead (80 μg/L) in an unfiltered sample was above the groundwater screening value of 15 μg/L (SDWA MCL), and also above the MCP GW-3 value for groundwater not used for drinking water of 30 μg/L. However, the lead level in the filtered samples dropped to below the detection limit. In filtered samples from well E3-P13-M01, the level of manganese (102 μg/) was above the Massachusetts SMCL of 50 μg/L and the sodium level (36,200 μg/L) was above the EPA's Health Advisory level of 20,000 μg/L. Again, these levels are probably natural in the case of manganese, and due to road salting in the case of sodium.

No organic compounds were found at well E3-P13-M01, with the exception of TPHCs (535 μg/L), which are below the screening value of 1,000 μg/L (MCP GW-1 groundwater value).

Analysis of an unfiltered sample from well EHA3, located approximately 75 feet northwest of White Pond Road, indicated aluminum (122 μg/L) and iron (745 μg/L) above screening levels. These concentrations are probably due to suspended solids. No compounds were found in the filtered sample above screening levels. Given the location at well EHA3, and the results of sampling at wells G3-P13-M01 and EHA3, no apparent impacts are indicated at Site P13 on groundwater into northern groundwater divide.

In the surface water sample taken in December 1993 from the groundwater seep located across White Pond Road, north of Site P13, mercury was detected at 0.244 μg/L, which is above the screening value (MA/CWA WQC for consumption of water and fish of 0.14 μg/L). Because the source of this water is groundwater including drainage from the northern side of Site P13 (in addition to drainage from Site A8/P10 and Site P11), the mercury result was also compared to the groundwater screening value and found to be below the SDWA MCL of 2 μg/L. No mercury was detected at wells at Site P11 or Site P13 which are downgradient of the buildings at these sites, but upgradient of the seep, thus indicating that the mercury result is not related to Site P11 or Site P13. Surface water at the seep was barely flowing at the time of sampling. The sample contained a large amount of suspended solids. Arsenic, copper, cadmium, lead, and nickel were also found above screening levels in the water sample of the seep, but like the mercury are thought to be unrelated to Site P13.

The detailed contours of groundwater elevations incorporating data from Sites A7, A8, A9, A10, P11, P13, and P57 clearly show that the perennial stream north of White Pond Road and its associated wetlands are groundwater discharge points from both east and west (see Plate 3, the 190-foot contour). Because of the configuration of the water table it is clear that the spring and its adjoining wetland captures groundwater from at least part of Site A8, part of Sites P13 and P11, and all of Site P57. The spring itself, depending on its average

rate of flow, may only intercept flow from part of Site P13 and the area north of White Pond Road between Site P13 and the spring. If this area is approximately 300 feet wide and 800 feet long, and infiltration is equivalent to 22 inches per year, the average groundwater discharge would be approximately six gallons per minute or 9,000 gallons per day. This is in accord with field observations.

Because of this low flow and the highly organic and fine-grained nature of the sediments at the spring, there is no natural area of flowing water with a clean sandy bottom where sample containers can be submerged without the sample becoming turbid with suspended solids. The relatively high levels of metals in the sample collected on 1 December 1993 (E3-P13-D03) is confirmed to be the result of suspended solids by comparison with a sample from the same location taken at a later date (26 April 1994). The April 1994 surface water sample was taken from a small basin that was excavated 24 hours prior to samplig in order to obtain a non-turbid sample. The results of data of the resampling on 26 April 1994, show that the sample had no constituents that exceeded surface water screening levels. The low TSS of 5 μg/L shows that a non-turbid sample of this groundwater at its discharge point to surface water contains no detectable mercury, lead, arsenic, antimony, chromium, cobalt, nickel, or thallium. It shows low levels of silver (2.31 μg/L), barium (7.85 μg/L), beryllium (0.268 μg/L), copper (4.03 μg/L), vanadium (2.84 μg/L), and zinc (49.8 μg/L), none of which exceed any screening level.

Clays, silts, and organic matter are all typically higher in metals content than sands or coarser sediments. Surface water samples made turbid by sediment will almost always show elevated metals. If the parent materials contain metals, which is the case of the glacial sediments, the origin materials are the metamorphic and igneous bedrock of New England and Canada. In addition, there is a pile of trash including metal on the bank across the spring.

In the sediment sample taken at the groundwater seep, arsenic (11.6 μg/g), nickel (26.0 μg/g), and silver (1.89 μg/g) were found above background and screening levels. However, the concentrations of these metals are below NOAA ERM levels. Although these concentrations are above screening levels, these metals were not elevated in groundwater at Site P11/P13 or Site A8/P10 and their source is probably natural or related to the debris found in the back of the spring. No pesticides were detected in the sediment sample taken at the groundwater seep. TPHCs were detected at 106 μg/g, which is above the lowest effect level for TPHC used for screening of 2 μg/g (Ontario MOE LEL). This level is well below the soil screening value for TPHC of 500 μg/g.

Southern Groundwater and Surface Water Drainage from Site P13

Aluminum, iron, and manganese were detected at levels above screening values in unfiltered samples from the four wells (E3-P13-M02, E3-P13-M04, ATEC1, ATEC2) in the southern groundwater drainage. Aluminum values were not measured in the filtered samples from the two newly installed wells due to laboratory contamination. Manganese was elevated in the filtered sample from E3–P13–M02 at 271 μg/L, which is above the screening value of 50 μg/L (MA SMCL). This is probably due to natural levels in the groundwater. No organic

Table 2-20

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P13

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1]	--	50	MA SMCL[3]	32,000	E3-P13-M01	6/6
	Aluminum(F)[2]	--			121*	E3-P13-M02	1/1
	Iron(U)	--	300	MA SMCL	38,000	E3-P13-M01	6/6
	Iron(F)	--			677*	E3-P13-M02	1/2
	Lead(U)	--	15	SDWA MCL[4]	80.2	E3-P13-M01	1/6
	Lead(F)	--			<5.00	E3-P13-M01	0/6
	Manganese(U)	--	50	MA SMCL	763	E3-P13-M01	6/6
	Manganese(F)	--			271	E3-P13-M02	3/6
	Sodium(U)	--	20,000	EPA Health	42,400	E3-P13-M02	3/6
	Sodium(F)	--		Advisories	43,700	E3-P13-M03	2/6
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[5]	4.60	E3-P13-D01	1/3
	Iron	4,810	1,000	MA/CWA WQC[6]	5,100	E3-P13-D01	2/3
	Lead	10.3	3.2	MA/CWA WQC[6]	12.3	E3-P13-D03	2/3
	DDD	---	0.00083	MA/CWA WQC[5]	0.018(J)[10]	E3-P13-D03	2/4
	DDE	---	0.00059	MA/CWA WQC[5]	0.055	E3-P13-D03	2/4
	DDT	---	0.00059	MA/CWA WQC[5]	0.263	E3-P13-D03	2/4
SED (μg/g)	Arsenic	2.03	30	MCP GW-1/S-1[7]	37.0	E3-P13-D04	1/5
			6	Ontario MOE LEL[8]			2/5
	Beryllium	0.18	0.4	MCP GW-1/S-1	0.697	E3-P13-D01	1/5
	Cadmium	0.357	<0.500	Ontario MOE LEL	1.43	E3-P13-D03	1/5
	Copper	6.33	16	Ontario MOE LEL	34.0	E3-P13-D01	2/5
	Iron	7,590	20,000	Ontario MOE LEL	140,000	E3-P13-D01	2/5
	Lead	4.48	31	Ontario MOE LEL	72.2	E3-P13-D01	1/5
	Nickel	5.92	16	Ontario MOE LEL	29.1	E3-P13-D01	2/5
	Zinc	20.8	120	Ontario MOE LEL	370	E3-P13-D03	2/5
	DDD	---	0.002	NOAA ERL[9]	0.760	E3-P13-D01	5/5
	DDE	---	0.002	NOAA ERL	0.540	E3-P13-D01	5/5
	DDT	---	0.001	NOAA ERL	0.230	E3-P13-D03	4/5
	TPHC	16.6	2	Ontario MOE LEL	295	E3-P13-D02	2/5

*Some samples had no reported results due to laboratory or field contamination.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
[5]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for consumption of water and fish.
[6]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for aquatic life.
[7]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[8]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[9]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.
[10] J = Value is estimated.
Note: Wells included in this table were E3-P13-M01 through M04, and ATEC1 and ATEC2.
Source: Ecology and Environment, Inc. 1994.

compounds other than TPHC were detected in sampling of the four wells in the August 1993 round. TPHC was detected in well E3-P13-M02 at a maximum estimated value of 332 μg/L, which is below the groundwater screening value of 1,000 μg/L (MCP GW-1 groundwater value).

Surface water samples were collected for the downstream runoff pathway from Site P13. Arsenic, iron, lead, and zinc were found at concentrations above both background and surface water screening levels. Arsenic (4.60 μg/L) was found (in E3-P13-D01) at a concentration above the MA/CWA WQC for consumption of fish and water of 0.018 μg/L and the WQC for consumption of fish only of 0.14 μg/L, but below the WQC for protection of aquatic life of 190 μg/L. This arsenic level is only slightly elevated above the maximum detection in background streams of 3.15 μg/L. Arsenic levels in surface water further downstream decline to background levels. Iron (5,100 μg/L), lead (12.3 μg/L), and zinc (181 μg/L) were also found in concentrations above the MA/CWA WQC for the protection of aquatic life for iron (1,000 μg/L), lead (3.2 μg/L), and zinc (110 μg/L) in the samples taken closer to the site but not further downstream.

DDT and its degradation products DDD and DDE were also found in the surface water samples at low levels that are above the MA/CWA WQC for consumption of water and fish for these compounds although this stream could not be a source for water or fish for consumption. The level of DDT (0.263 μg/L) at sample point E3-P13-D03 was also above the WQC for the protection of aquatic life. The concentrations of DDD and DDE at E3-P13-D01, which is downstream of E3-P13-D03, were lower than the upstream sample, and DDT was not detected at this point. DDT, DDD, and DDE were not detected in the water samples (E3-P13-D04, E3-P13-D05) taken further downstream from E3-P13-D03, indicating some limited surficial runoff containing these compounds from Site P13, with declining impact as distance increases from the site.

Analysis of sediment samples taken in relation to Site P13 indicated elevated metals in the sediment samples taken closer to the site (E3-P13-D01, E3-P13-D02, and E3-P13-D03), and at levels declining to background in the more distant samples (E3-P13-D04 and E3-P13-D05). One notable exception is the arsenic detection (37.0 μg/g) at E3-P13-D04, which is three times the highest upstream detection at E3-P13-D01 of 11.2 μg/g. This arsenic level was above the sediment screening value of 6 μg/g, and is also above the soil screening value of 30 μg/g (MCP GW-1/S-1). Given that E3-P13-D04 is located downgradient of Site P26 and adjacent to a road crossing the drainage, the source of this arsenic detection is unlikely to be related to Site P13. The maximum levels of cadmium, iron, and zinc were at sample point E3-P13-D03 (immediately southeast of the site) and of copper, lead and nickel were at E3-P13-D01 (downstream at the junction of two drainages from Site P13). All of these metals were significantly elevated above background levels and were also above sediment screening levels. The zinc detection (370 μg/g) at E3-P13-D03 was also above the NOAA ERM level. As noted above, with the exception of arsenic, analysis of the more distant downstream sediment samples (E3-P13-D04 and E3-P13-D05) indicated slightly elevated levels of several metals above background (lead, nickel, and selenium), but none above sediment screening values.

The PAH compounds benzo(b)fluoranthene, fluoranthene, and pyrene were detected at the downstream sediment sample E3–P13–D05 at concentrations below sediment screening levels. No PAHs were detected in samples upstream of this sample.

DDT or its degradation products DDD and DDE were detected in all of the sediment samples taken at concentrations above sediment screening values. The highest detection of DDT (0.230 μg/g) was at E3–P13–D03, the sediment sampling location closest to the site itself. The highest concentrations of DDD (0.760 μg/g) and DDE (0.540 μg/g) were detected at E3–P13–D01, at the confluence of two drainages from the site. The concentrations of DDT, DDD, and DDD at points downstream of E3–P13–D01 declined, but were still above sediment screening values. No DDT was detected at the sediment sample (E3–P13–D05) taken the furthest downstream from Site P13, although DDD and DDE were still present. These results indicate some low-level migration of DDT and its breakdown products from the site, declining as distance increases from the site. Given the relatively low levels (none of the detections were over 1 μg/g), the likely source of DDT was general spraying at Site P13 rather than a spill or dumping of material containing DDT.

TPHCs were detected at sample points E3–P13–D03 (263 μg/g) and E3–P13–D01 (295 μg/g), but not at points further downstream, probably indicating some low level runoff from Site P13.

2.2.4.8 Conclusions and Recommendations

A remedial investigation is currently underway at Sites P11 and P13. Conclusions regarding the status of Site P13 will be included in the RI.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-21
Chemical Summary Report For Groundwater
Site: P13
Units: UGL

	Site ID	E3-P13-M01	E3-P13-M01	E3-P13-M01	E3-P13-M01	E3-P13-M02	E3-P13-M02
	Field Sample ID	MF1301X1	MFP13012	MX1301X1	MXP13012	MF1302X1	MFP13022
	Sample Date	08/25/93	11/29/93	08/25/93	11/29/93	08/24/93	11/30/93
Test	Parameter						
TAL METAL	Aluminum	55.4 B@	29.5 B	32000 @	8300 @	15.1 BJ	121 K@
	Antimony	6.76 B@	6.24 B@	2.39 J	12.3 @	12.3 B@	6.85 B@
	Arsenic	1.54 J	1.54 J	37.5 J	14.5	2.81	< 2.00
	Barium	26.6	35.6	198	73.2	12.3	32.6
	Beryllium	0.147 BJ	< 5.00	1.56 J	0.396 J	< 5.00	< 5.00
	Cadmium	< 5.00	< 5.00	3.45 J	< 5.00	< 5.00	2.97 J
	Calcium	16100	11400	20700	13500	12100	21500
	Chromium	< 10.0	< 10.0	58.9	11.8	< 10.0	< 10.0
	Cobalt	< 10.0	< 10.0	25.0	6.07 J	< 10.0	< 10.0
	Copper	1.52 J	< 10.0	39.5	11.2	2.45 J	< 10.0
	Iron	50.9 B	24.2 BJ	38000 @	8930 @	146 B	127 B
	Lead	< 5.00	< 5.00	80.2 @	21.9 @	< 5.00	< 5.00
	Magnesium	4240	1830	14200	4020	870	1850
	Manganese	102 @	89.1 @	515 @	186 @	271 @	47.0
	Nickel	< 10.0	< 10.0	48.4	14.7	< 10.0	< 10.0
	Potassium	2640	3040 B	9520	4560 K	2710	4980
	Sodium	23000 @	36200 @	23700 @	36600 @	4830	43900 @
	Vanadium	< 10.0	< 10.0	60.0	14.2	< 10.0	< 10.0
	Zinc	21.7 B	10.7 BJ	109 K	44.2	79.8 B	18.8 BJ
TCL Pest	Endosulfan,A			< 0.080	0.030 U		
	beta-BHC			< 0.080	< 0.020		
	delta-BHC			< 0.080	0.034 C		
TPHC	Total Petroleum Hydrocarbons			535 J	< 2000		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. #=Exceeds ecological screening value
C= Confirmed on second column; U= Unconfirmed. K= Result bias high. R= Result rejected. @= Exceeds human health screening value. != Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-21
Chemical Summary Report For Groundwater
Site: P13
Units: UGL

	Site ID	E3-P13-M02	E3-P13-M02	E3-P13-M03	E3-P13-M03	E3-P13-M03	E3-P13-M03
	Field Sample ID	MX1302X1	MXP13022	MF1303X1	MFP13032	MX1303X1	MXP13032
	Sample Date	08/24/93	11/30/93	08/25/93	11/30/93	08/25/93	11/30/93
Test	Parameter .						
TAL METAL	Aluminum	269 K@	5800 @	14.2 BJ	28.9 B	5440 @	157 @
	Antimony	< 5.00	< 5.00	10.7 B@	< 5.00	< 5.00	< 5.00
	Arsenic	3.89 J	5.18	< 2.00	1.63 J	5.99 J	2.81
	Barium	15.7	60.8	37.7	10.2	69.3	10.3
	Beryllium	< 5.00	< 5.00	0.096 BJ	< 5.00	0.378 J	< 5.00
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
	Calcium	12200	21200	24900	15100	25500	15400
	Chromium	< 10.0	10.0 J	< 10.0	< 10.0	13.3	< 10.0
	Cobalt	< 10.0	4.46 J	4.68 J	< 10.0	7.72 J	< 10.0
	Copper	1.54 J	13.9	1.57 J	< 10.0	6.55 J	< 10.0
	Iron	445 @	6960 @	< 25.0	677 K@	6600 @	889 @
	Lead	< 5.00	2.71 BJ	< 5.00	< 5.00	3.11 J	1.61 BJ
	Magnesium	864	3540	2180	915	3900	954
	Manganese	270 @	133 @	124 @	172 @	210 @	165 @
	Nickel	< 10.0	8.17 J	< 10.0	< 10.0	15.5	< 10.0
	Potassium	2600	3820	3800	2540	4960	2130
	Sodium	4590	42400 @	43700 @	5650 K	42200 @	4780 K
	Vanadium	< 10.0	13.6	< 10.0	< 10.0	11.1	< 10.0
	Zinc	68.0 K	416	21.6 B	13.0 BJ	27.0 B	11.6 BJ
TCL Pest	Endosulfan,A	0.028 U	< 0.020			< 0.080	< 0.020
	beta-BHC	< 0.020	< 0.020			< 0.080	< 0.020
	delta-BHC	0.058	< 0.020			< 0.080	< 0.020
TPHC	Total Petroleum Hydrocarbon	328 J	467 BJ			332 J	< 2000

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-21
Chemical Summary Report For Groundwater
Site: P13
Units: UGL

	Site ID	E3-P13-M04	E3-P13-M04	E3-P13-M04	E3-P13-M04		
	Field Sample ID	MF1304X1	MFP13042	MX1304X1	MXP13042		
	Sample Date	08/24/93	11/29/93	08/24/93	11/29/93		
Test	Parameter .						
TAL METAL	Aluminum	34.8 B	52.1 B@	2140 @	1110 @		
	Antimony	2.49 BJ	< 5.00	< 5.00	< 5.00		
	Arsenic	< 2.00	1.12 J	< 2.00 J	0.830 J		
	Barium	< 10.0	< 10.0	23.9	20.9		
	Beryllium	< 5.00	< 5.00	0.175 J	< 5.00		
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00		
	Calcium	2180	2130	3290	3410		
	Chromium	6.16 J	< 10.0	< 10.0	< 10.0		
	Cobalt	< 10.0	< 10.0	< 10.0	< 10.0		
	Copper	< 10.0	< 10.0	1.75 J	4.09 J		
	Iron	16.5 BJ	40.7 B	1560 @	903 @		
	Lead	< 5.00	< 5.00	< 5.00	1.19 BJ		
	Magnesium	216 KJ	205 J	763	423 J		
	Manganese	32.0	20.5 K	63.1 @	32.3		
	Nickel	< 10.0	< 10.0	< 10.0	9.08 J		
	Potassium	596 J	864 BJ	1180	1030 B		
	Sodium	2590	4260 B	2980	3520 B		
	Vanadium	< 10.0	< 10.0	4.27 J	< 10.0		
	Zinc	13.9 BJ	22.9 K	29.1 B	29.4 K		
TCL Pest	Endosulfan.A			< 0.020	0.028 C		
	beta-BHC			< 0.020	0.033 C		
	delta-BHC			< 0.020	0.033 C		
TPHC	Total Petroleum Hydrocarbons			< 2000	< 2000		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

#=Exceeds ecological screening value
B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 2-22
Chemical Summary Report For Subsurface Soils
Site: P13
Units: UGG

	Site ID	E3-P13-M01	E3-P13-M02	E3-P13-M03	E3-P13-M04		
	Field Sample ID	BX1301X1	BX1302X1	BX1303X1	BX1304X1		
	Sample Date	08/02/93	08/03/93	08/03/93	08/02/93		
Test	Parameter Depth	0.0 ft.	9.0 ft.	9.0 ft.	0.0 ft.		
TOC	Total Organic Carbon	4310	5660	4330	6130		

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 2-23
Chemical Summary Report For Surface Waters
Site: P13
Units: UGL

	Site ID	E3-P13-D01	E3-P13-D01	E3-P13-D03	E3-P13-D04	E3-P13-D05	
	Field Sample ID	WX1301X1	WXP13012	WXP13032	WXP13042	WXP13052	
	Sample Date	08/02/93	12/01/93	12/01/93	12/01/93	12/01/93	
Test	Parameter .						
TAL METAL	Aluminum	501 J!		746 J!		207 J	
	Arsenic	4.60 !@		2.22 @		1.41 J@	
	Barium	24.6 !		11.8 J!		9.31 J	
	Calcium	11000 !		4690		8450	
	Copper	5.60 J		4.08 J		< 10.0	
	Iron	5100 !#		1420 J#		328 J	
	Lead	11.1 !#		12.3 !#		< 5.00	
	Magnesium	2610 !		533		1760	
	Manganese	91.8		33.3		48.3	
	Potassium	6010 !		668 BJ		932 BJ	
	Sodium	6350		3960 B		6350 K	
	Vanadium	3.38 J		3.51 J		< 10.0	
	Zinc	70.8 !		181 !#		23.9 !	
TCL Pest	P,P-DDD	0.016 JC@		0.018 JC@	< 0.048	< 0.040	
	P,P-DDE	0.019 JC@		0.055 C@	< 0.048	< 0.040	
	P,P-DDT	< 0.040		0.263 C@#	< 0.048	< 0.040	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 2-24
Chemical Summary Report For Sediments
Site: P13
Units: UGG

	Site ID	E3-P13-D01	E3-P13-D01	E3-P13-D01	E3-P13-D02	E3-P13-D02	E3-P13-D03
	Field Sample ID	DD1301X1	DX1301X1	DXP13012	DX1302X1	DXP13022	DX1303X1
	Sample Date	08/02/93	08/02/93	12/01/93	08/02/93	12/01/93	08/03/93
Test	Parameter .						
TAL METAL	Aluminum	5280 !	4100		4500		3700
	Arsenic	11.2 !#	9.86 !#		3.46 !		4.71 !
	Barium	59.5 !	59.0 !		14.7		16.4
	Beryllium	0.697 J!@	0.566 J!@		0.198 J!		0.166 J
	Cadmium	< 0.500	< 0.500		< 0.500		1.43 K#
	Calcium	20200 !	19400 !		566 !		480 J
	Chromium	11.3 J!	9.79 J!		9.78 !		15.2 !
	Cobalt	10.7 !	9.10 !		4.44 !		7.07 !
	Copper	34.0 !#	9.10 !		5.42		29.6 !#
	Iron	140000 !#	13000 !		7200		26000 !#
	Lead	72.2 !#	69.7 !#		6.00 !		23.0 !
	Magnesium	2350 J!	1980 J		1990		1450
	Manganese	66.6	76.6 !		77.2 !		84.3 !
	Nickel	29.1 !#	23.9 !#		8.51 !		12.0 !
	Potassium	< 200	< 200		1060		669
	Selenium	2.65 !	1.94 !		< 0.200		< 0.200
	Vanadium	30.9 !	22.9 !		13.0		11.4
	Zinc	269 !#	277 !#		15.9		370 !#
TCL BNA	Benzo(b)fluoranthene	< 2.00	< 2.00		< 0.330		< 2.00
	Fluoranthene	< 2.00	< 2.00		< 0.330		< 2.00
	Pyrene	< 2.00	< 2.00		< 0.330		< 2.00
TCL Pest	P,P-DDD	0.690 C#	0.760 C#		0.008 JC#		0.170 C#
	P,P-DDE	0.480 C#	0.540 C#		0.022 C#		0.120 C#
	P,P-DDT	0.110 JC#	0.150 C#		0.012 C#		0.230 C#
TOC	Total Organic Carbon	592000	628000		12800		26200
TPHC	Total Petroleum Hydrocarbon	55.1 !#	295 !#		< 20.0		263 !#

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 2-24
Chemical Summary Report For Sediments
Site: P13
Units: UGG

	Site ID	E3-P13-D03	E3-P13-D04	E3-P13-D04	E3-P13-D05	E3-P13-D05	
	Field Sample ID	DXP13032	DX1304X1	DXP13042	DX1305X1	DXP13052	
	Sample Date	12/01/93	08/03/93	12/01/93	08/03/93	12/01/93	
Test	Parameter .						
TAL METAL	Aluminum		4400		2500		
	Arsenic		37.0 !@#		0.941		
	Barium		16.4		10.9		
	Beryllium		0.365 J!		0.062 J		
	Cadmium		0.287 BJ		< 0.500		
	Calcium		1170 !		737 !		
	Chromium		7.66		4.23		
	Cobalt		3.17		1.39 J		
	Copper		4.37		2.21		
	Iron		6600		3000		
	Lead		23.0 !		7.21 !		
	Magnesium		1170		796		
	Manganese		42.9		31.9		
	Nickel		7.89 !		4.02		
	Potassium		424 K		311 K		
	Selenium		0.537 !		< 0.200		
	Vanadium		11.4		4.90		
	Zinc		15.0		12.0		
TCL BNA	Benzo(b)fluoranthene		< 0.330		0.082 J		
	Fluoranthene		< 0.330		0.120 J		
	Pyrene		< 0.330		0.068 J		
TCL Pest	P,P-DDD		0.020 C#		0.025 C#		
	P,P-DDE		0.037 C#		0.022 C#		
	P,P-DDT		0.019 C#		< 0.008		
TOC	Total Organic Carbon		79800		35400		
TPHC	Total Petroleum Hydrocarbons		< 20.0		< 20.0		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

2.2.5 Site P23 — Building T465-Drums

Site P23 was identified during a general site reconnaissance carried out by OHM and USAEC in 1991. During this site visit, drums were discovered in and around Building T465. Figure 2-6 provides a site map.

2.2.5.1 Site Location

Site P23 lies in the north-central part of the Annex beside Puffer Pond Road, approximately 2,000 feet northeast of Puffer Pond. There is a clearing on both sides of the road. Building T465 is built on top of a 35 foot by 85 foot concrete pad. In front of the building, there is a second, 45 foot by 25 foot concrete pad. A road diverges from Puffer Road and leads up to the area between the smaller concrete pad and the pad on which Building T465 stands. There is an outhouse about 500 feet east of Building T465 within the forest.

2.2.5.2 Physical Characteristics

Site P23 is located in an area of gently sloping glacial outwash sand and gravel. The surface elevation at Site P23 is approximately 195 feet AMSL. Average groundwater elevation is 184 feet AMSL.

One monitoring well (E3-P23-M01) was installed by E & E in 1993. The boring logs at this location shows a coarse sand and gravel mixture, typical of an outwash plain extending through the total depth of 19.6 feet achieved at this location. Grain size analysis performed on a soil sample collected from the 14 to 16 foot interval at well E3-P23-M01 identified the soil as non-plastic poorly graded sand with gravel. An addition geotechnical analysis was performed on surface soil sample E3-P23-S01. The surface soil was subsequently identified as non-plastic, well graded sand with silt and gravel. Please refer to Appendix D for a complete summary of geotechnical results. Bedrock was not encountered during this exploration but is projected to be Gospel Hill Gneiss (Hansen 1956). Depth to bedrock is unknown. A seismic study performed for the Town of Maynard indicated depths to bedrock of 50 to 70 feet north of Honey Brook, and boreholes indicated that the lower part of the outwash (below 20 feet) was of low transmissivity (Dufresne-Henry 1982).

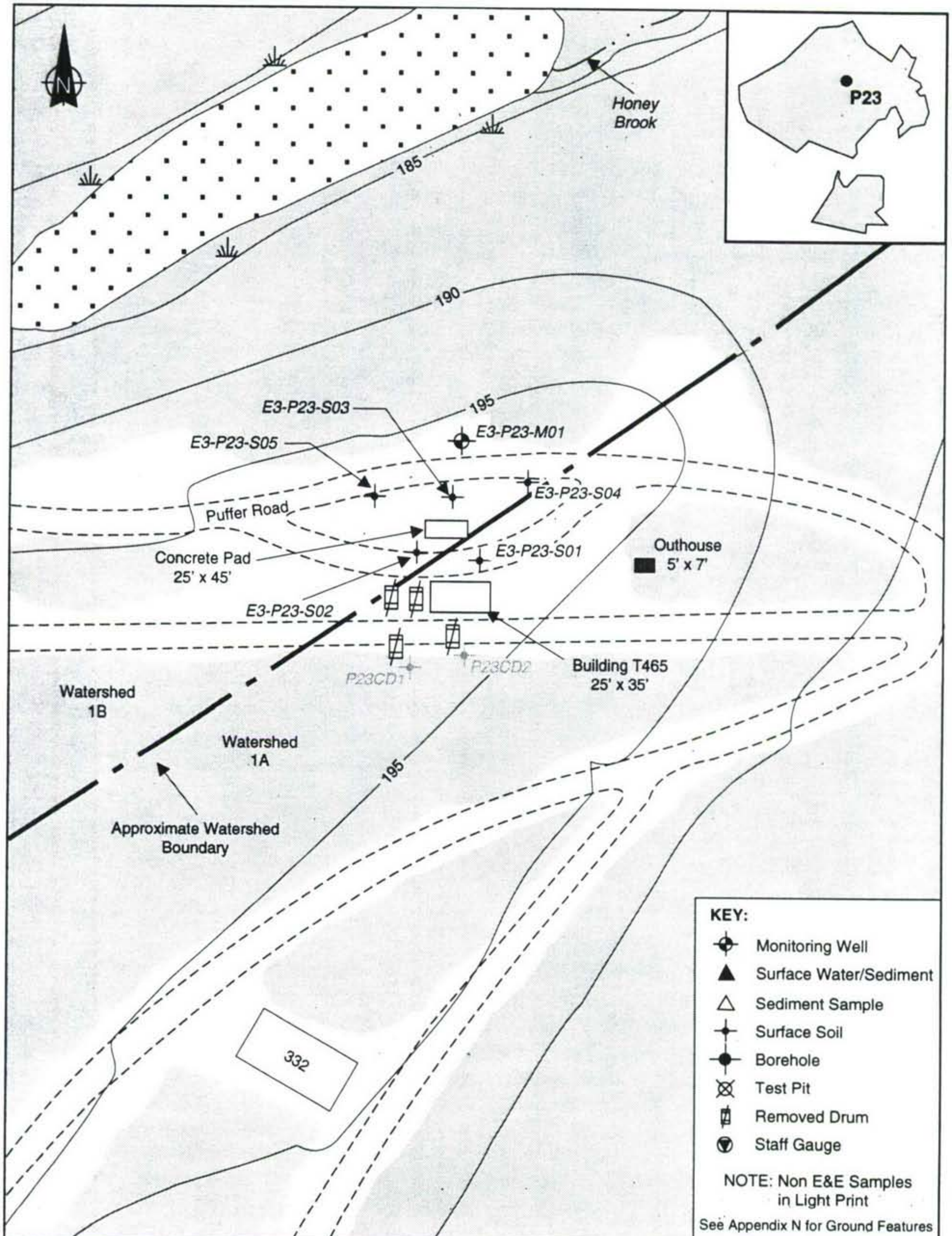
A slug test performed on monitoring well E3-P23-M01 yielded an aquifer transmissivity of 246.6 feet^2 per day based on a presumed aquifer thickness equal to the length of the water column within the well. The transmissivity was calculated as follows:

$$T = Kb$$
$$T = (36.60)\,(6.74)$$
$$T = 246.68 \text{ feet}^2 \text{ per day}$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer Thickness (feet)

11: M:\SUDBURY\UC6_P23.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 2-6 MAP OF SITE P23
BUILDING T465 (DRUMS)

Complete slug test data and information can be found in Appendix G. The low transmissivity (less than 1,350 feet^2 per day) may in fact be a slight underestimate due to the conservative aquifer thickness assumption. It is well below the upper bound of transmissivity used to define a low yield aquifer (1,350 feet^2 per day), as defined by 310 CMR 40.0006.

The boundary between Watershed 1B — Lower Taylor Brook and Watershed 1A — Upper Taylor Brook passes through the southeastern portion of the site. Surface water north of the boundary drains northwest to Honey Brook which, in turn, flows into Taylor Brook. Surface water south of the boundary flows east to a nearby wetland drained by Taylor Brook. Based on topography and drainage, groundwater probably flows both northwest to Honey Brook and east toward the wetland.

2.2.5.3 Ecological Characterization

The site consists of a open developed area with a building, a concrete pad, and an outhouse. Site P23 is vegetated with grasses, forbs, and shrubs. A dense growth of white pine and oak trees ranging from 40 to 60 feet in height edges the site on all sides except from the north. Approximately 150 feet north of the site adjacent to Honey Brook, the vegetative cover type consists of young white pines and hardwood trees ranging from 20 to 40 feet in height (LFS 1983).

Based on the topography of the area, groundwater and surface water flow is to the northeast towards Honey Brook and its confluence with Taylor Brook (E & E 1993). Approximately 200 feet north and downgradient of Site P23 there is a small permanent open water wetland (USDOI 1977) which is formed by damming Honey Brook. In addition, seasonally saturated forested wetlands vegetated with shrubs and deciduous trees occur on both sides of Taylor Brook.

In general, this area consists of several distinct habitats including developed open areas, upland forest, forested wetland and open water. Despite the presence of the an abandoned building and cement pads, the open area at the site is expected to attract a variety of wildlife including ground nesting birds, small mammals, raptors and deer. Pines and oaks are important to wildlife since upland gamebirds, songbirds, and small mammals rely on pine seeds and acorns for much of their diet (Martin *et al.* 1951). In addition, these trees also serve as cover for deer and rabbits, especially in the winter.

Open bodies of water such the wetland north of the site provide drinking water, food and breeding areas for many species including amphibians, reptiles, waterfowl, and piscivorous birds. Since forested wetlands combine an abundance of nutrients, the presence of diverse woody species, and the availability of water, they also attract a diverse array of aquatic species, upland species, as well as species specifically adapted to wetlands. Streams like Taylor Brook and Honey Brook provide long edge habitats, drinking water, protected sites for dens and nests, and safe travel corridors for many species. Fish, crustaceans, insects, plants, reptiles, amphibians, birds, and many upland species can be observed in this habitat type.

No unique habitats are known to occur in the general vicinity of the site (NHESP 1992). Similarly, no rare, threatened, or endangered species have been identified near the site.

2.2.5.4 Site History

Site P23 was identified during a site reconnaissance (OHM 1991; USAEC 1991), in which several drums were observed in and around Building T465. Several drums were found inside the building, on the concrete pad just outside the building, and on the old road (a former railway bed) that passes immediately south of the building.

Building T465 has been used by the Air Drop Engineering Division of Natick Laboratories for aerial delivery testing and as an aircraft roller test facility. The prefabricated test building, consisting of insulated fiberglass panel, was constructed in 1960. A concrete pad called an aerial delivery drop test slab was constructed immediately north of Building T465. A crawler crane was used to simulate air drops, and material would be tested by dropping it on the concrete pad. A 1966 memo noted that the facility was being used for between 8 and 10 drops per month.

In 1967, the field north of Building T465 was used by GCA Corporation of Bedford, Massachusetts, for optical and electronic instrument evaluation in measuring smoke obscurance. Experiments involved the release of smoke by smoke hand grenades, generator smoke, mechanical pulse, fog oil, and smoke pots. This activity continued for six months.

In 1971, the building was described as an aircraft roller test facility. The 1978 Natick Environmental Assessment described the area still used by the Aero-Mechanical Engineering Laboratory as an aircraft roller conveyor test facility. A 1983 memo noted that the static test airdrop facility was relocated to Natick.

2.2.5.5 Results of Previous Investigations

In 1991, the Phase I SI conducted by OHM at Site P23 included removal of four empty 55-gallon drums and confirmatory sampling at two of the drum locations (P23CD1 and P23CD2) to determine whether any contamination had been introduced into the area. Confirmatory soil samples were tested for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, TAL metals, and explosives.

Removals

The drums that were found in the vicinity of Building T465 were removed and staged at Site P23. Pesticides, PAHs, miscellaneous organic compounds, and elevated levels of metals were found at P23CD2. Many of the same compounds were also present at P23CD1 at lower concentrations. High levels of arsenic (110 μg/g) was detected in sample P23CD2. However, lead (16,000 μg/g) in sample P23CD1 was the highest of all the soil samples taken at the Annex to date.

2.2.5.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and TPHC. All surface soil samples and all subsurface soil samples were analyzed for TOC. In addition, one surface soil and one subsurface soil sample were sent for geotechnical analysis to determine grain size. A summary of Phase II Sampling Activities at Site P23 is provided as Table 2-25.

Table 2-25

PHASE II SAMPLING EFFORTS AT SITE P23 — BUILDING T465-DRUMS

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	2	08/26/93 12/02/93	Samples were collected to investigate the groundwater pathway and the potential for contaminant migration off-site.
Subsurface Soils	1	08/04/93	Geotechnical sample was collected from the screened interval to characterize the nature of subsurface soils in the area and their impact upon the groundwater pathway.
	1	08/04/93	Sample was collected for TOC analysis for assessment of the potential for contaminant migration through the groundwater pathway.
Surface Soils	5	08/31/93	Samples were collected to characterize the nature of surface soil contamination on-site and the potential for the soils to act as a source of future contamination.
	5	08/31/93	Samples were analyzed for TOC.
	1	08/31/93	Geotechnical sample was collected at location E3-P23-S01 to characterize the nature of surface soils.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

To characterize groundwater quality downgradient of Building T465, E & E installed, developed, and sampled one shallow overburden monitoring well, E3-P23-M01. Both an unfiltered as well as a filtered sample were collected. The well was located approximately 100 feet northwest of Building T465, downgradient from the site and across Puffer Road. The well is screened across the water table at an interval 9.6 to 19.6 feet BGS. A total of two rounds of groundwater samples were collected from the well during August and December 1993. The groundwater data is used to assess the potential for any contamination to migrate off-site through the groundwater pathway to Honey Brook.

Subsurface Soil Sampling

Samples were collected from the screened interval during well construction and sent for grain size analysis. In addition, a second sample was collected from the saturated zone and sent for TOC analysis. These samples will provide data to assess the nature of subsurface soils and their impact upon the groundwater pathway.

Surface Soil Sampling

A total of five surface soil samples were collected from areas of discoloration or from surface runoff drainage channels. All samples were collected downgradient from the area suspected of being used in the past for storage of drums. All surface soil samples were analyzed for TOC. In addition, sample E3-P23-S01 was analyzed for grain size. Sample analysis will help investigate the nature of surface soil contamination, if any, on-site.

2.2.5.7 Nature and Extent of Contamination

Arsenic and lead were previously detected at elevated levels in drum confirmation soil samples taken at two former drum locations directly south of Building T465. Arsenic (65.2 μg/L, estimated) and lead (46.1 μg/L) were detected in the unfiltered groundwater sample from the newly installed well, E3-P23-M01, in the August 1993 sampling around above screening levels but below screening levels in the unfiltered samples taken in the December 1993 sampling round. Arsenic and lead were below the detection limit in filtered groundwater samples from this well. The arsenic and lead levels in the unfiltered groundwater sample in the August 1993 round were above the groundwater screening values for arsenic (50 μg/L, MA MCL) and lead (15 μg/L, MA MCL). The lead level in the unfiltered sample was also above the MCP GW-3 level for groundwater not used as drinking water. Aluminum, iron and manganese were also above screening value in unfiltered samples, but of these, only manganese (63.9 μg/L) in the August 1993 round was found above the screening value of 50 μg/L (MA SMCL) in a filtered sample. No other organic compounds were detected in sampling at this well.

While several metals were elevated above background levels in soil samples taken at Site P23, only lead (320 μg/g) in sample E3-P23-S02 was found in a concentration above soil screening levels. This lead detection was at a sample taken immediately downgradient of Building T465, and exceeded the MCP GW-1/S-1 soil value of 300 μg/g. However, the lead detection was below the MCP GW-3/S-3 level of 600 μg/g and below the EPA Interim Cleanup Level for Lead at Superfund Sites of 500 μg/g. Several PAH compounds were detected in the sample at E3-P23-S01 and E3-P23-S04, but none were elevated above soil screening values. Given traffic through this area, the PAHs are likely the result of car combustion and exhaust. Pesticides were found at trace levels in various of the soil samples, mostly below the maximum detections in background soils, and none at concentrations above soil screening values. TPHCs were found in all soil samples at the site, but were significantly elevated at only two samples (2,300 μg/g at E3-P23-S03; 15,000 μg/g at E3-P23-S05). The TPHC concentration at E3-P23-S05 was above the soil screening value of 500 μg/g (MCP GW-1/S-1) and also above the MCP GW-3/S-3 soil value. Given that this sample was taken

immediately adjacent to Puffer Pond Road, it may reflect oil or petroleum spilled or accumulated in the road area. A summary of detections above preliminary screening levels is provided as Table 2-26. Chemical summary reports for Site P23 are presented in Tables 2–27, 2-28, and 2-29 at the end of this section.

Table 2-26

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P23

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1]	--	50	MA SMCL[3]	26,000*	E3-P23-M01	1/1
	Aluminum(F)[2]	--				E3-P23-M01	0/1
	Arsenic(U)	--	50	MA MCL[4]	65.2	E3-P23-M01	1/1
	Arsenic(F)	--			<2.00	E3-P23-M01	0/2
	Iron(U)	--	300	MA SMCL	36,000	E3-P23-M01	1/1
	Iron(F)	--			<25.0	E3-P23-M01	0/1
	Lead(U)	--	15	MA MCL	46.1	E3-P23-M01	1/1
	Lead(F)	--			<5.00	E3-P23-M01	0/1
	Manganese(U)	--	50	MA SMCL	2,200	E3-P23-M01	1/1
	Manganese(F)	--			63.9	E3-P23-M01	1/1
SOIL (μg/g)	Lead	150	300	MCP GW-1/S-1[5]	320	E3-P23-S02	1/5
	TPHC	--	500	MCP GW-1/S-1	15,000	E3-P23-S05	2/5

*No reported results due to laboratory or field contamination.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MA MCL = Massachusetts Maximum Contaminant Level.
[5]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

2.2.5.8 Conclusions and Recommendations

The initial concern at this site was that contents of drums previously stored at this site may have spilled and affected the surrounding area. Drum confirmation samples taken previously at two former drum locations immediately south of the site indicated elevated levels of arsenic (110 μg/g) and lead (16,000 μg/g). No soil sampling was conducted by E & E around these confirmation sample points or downgradient of them. Analysis of soil samples taken by E & E north of the site indicate lead (320 μg/g) above screening values in one sample, and TPHCs above screening values (15,000 μg/g, maximum) in two samples. The lead level, while above the most conservative soil category used for screening (MCP GW-1/S-1, which is oriented toward residential use, and use of the groundwater for drinking), is below the EPA interim cleanup level for lead at Superfund site of 500 μg/g. The TPHC

level of 15,000 $\mu g/g$ is above several screening levels (MCP GW-1/S-1 and MCP GW-3/S-3), and indicates some petroleum contamination in the area around Puffer Pond Road as it passes the site. However, given that TPHC was detected at much lower levels in the two soil samples taken immediately downgradient of Building T465, petroleum contamination may be limited to the area around or downgradient of the concrete pad. Some arsenic and lead contamination also exists in the soil south of Building T465, where the two drums were formerly located, although the impacted area is probably limited given the source of contaminations is two 55-gallon drums.

Sampling of the well at Site P23 indicated the presence of lead and arsenic above groundwater screening values in unfiltered samples in one of two sampling rounds, but below the detection limit in filtered samples. This seems to indicate that these metal levels are the result of suspended solids in the unfiltered sample, and that lead and arsenic are not present in the groundwater in a dissolved form. Manganese was found at a level above the Massachusetts SMCL of 50 $\mu g/L$, but is probably due to naturally occurring manganese levels at the Annex.

Arsenic-, lead-, and TPHC-contaminated soil exists at two areas near Building T465. It is recommended that a SSI be conducted to determine the extent of lead, TPHC, and arsenic contaminated soil focusing on the following two areas. A removal action in the areas noted below would be recommended if the results of the study indicate that such an action is necessary:

- in the area north of Building T465, where lead and TPHC levels were elevated above screening values; and

- in the area around the former drum locations where arsenic and lead were found at high levels.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-27
Chemical Summary Report For Groundwater
Site: P23
Units: UGL

	Site ID	E3-P23-M01	E3-P23-M01	E3-P23-M01	E3-P23-M01
	Field Sample ID	MFP23011	MFP23012	MXP23011	MXP23012
	Sample Date	08/26/93	12/02/93	08/26/93	12/02/93
Test	Parameter				
TAL METAL	Aluminum	42.1 B	25.0 BJ	26000 @	9420 @
	Arsenic	< 2.00	< 2.00	65.2 J@	23.8
	Barium	15.7	7.03 J	172	55.9
	Beryllium	0.213 BJ	< 5.00	1.85 J	< 5.00
	Calcium	1830	2360	4920	4190
	Chromium	< 10.0	< 10.0	44.2	14.0
	Cobalt	< 10.0	2.82 J	37.2	9.25 J
	Copper	< 10.0	< 10.0	37.2	18.0
	Iron	18.4 BJ	< 25.0	36000 @	13000 @
	Lead	< 5.00	< 5.00	46.1 @	6.83 K
	Magnesium	662	597	6920	2910
	Manganese	63.9 @	36.0	2200 @	544 @
	Nickel	< 10.0	< 10.0	68.3	19.2
	Potassium	1110	< 1000	5420	2390 B
	Sodium	1900 KJ	2020 B	3060	3790 B
	Vanadium	< 10.0	< 10.0	45.8	16.3
	Zinc	13.6 BJ	6.04 BJ	85.1 K	69.2

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 2-28
Chemical Summary Report For Subsurface Soils
Site: P23
Units: UGG

	Site ID	E3-P23-M01					
	Field Sample ID	BX2301X1					
	Sample Date	08/04/93					
Test	Parameter Depth	14.0 ft.					
TOC	Total Organic Carbon	18600					

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-29
Chemical Summary Report For Surficial Soils
Site: P23
Units: UGG

	Site ID	E3-P23-S01	E3-P23-S01	E3-P23-S02	E3-P23-S03	E3-P23-S04	E3-P23-S05
	Field Sample ID	SDP23011	SXP23011	SXP23021	SXP23031	SXP23041	SXP23051
	Sample Date	08/31/93	08/31/93	08/31/93	08/31/93	08/31/93	08/31/93
Test	Parameter						
TAL METAL	Aluminum	4440	4040	4000	5730	5210	4250
	Antimony	0.370 BJ	0.310 BJ	0.938 K!	0.557 B!	0.332 BJ	0.479 BJ
	Arsenic	10.3 !	13.0 !	13.0 !	9.32	9.04	8.43
	Barium	22.4	18.4	14.9	67.0 !	21.3	16.5
	Beryllium	0.226 J	0.202 J	0.207 J	0.306 J	0.284 J	0.226 J
	Calcium	469 J	415 J	443 J	451 J	434 J	368 J
	Chromium	13.3	11.9	15.4 !	21.1 !	17.2 !	16.4 !
	Cobalt	5.13	4.74	7.78 !	6.37 !	6.21 !	4.87
	Copper	12.0 !	10.8 !	24.5 !	14.6 !	12.6 !	27.1 !
	Iron	6710	6340	26000 !	8250	7550	7090
	Lead	31.0	33.0	320 !@	82.0	35.0	52.0
	Magnesium	1430	1220	1320	1810	1660	1340
	Manganese	144 !	120 !	129 !	183 !	159 !	128 !
	Mercury	0.108	0.129	< 0.100	< 0.100	< 0.100	< 0.100
	Nickel	13.4 !	13.6 !	14.2 !	14.0 !	14.1 !	13.5 !
	Potassium	1080 !	759 !	704 !	1050 !	947 !	760 !
	Vanadium	11.0	9.87	11.8	14.6	13.6	13.1
	Zinc	32.9	30.8	2300 !	73.4 !	21.0	28.5
TCL BNA	Benzo(a)anthracene	< 0.330	< 0.330	< 0.330	< 0.330	0.074 J	< 0.330
	Benzo(a)pyrene	< 0.330	< 0.330	< 0.330	< 0.330	0.093 J	< 0.330
	Benzo(b)fluoranthene	0.036 J	< 0.330	< 0.330	< 0.330	0.140 J	< 0.330
	Benzo(k)fluoranthene	< 0.330	< 0.330	< 0.330	< 0.330	0.051 J	< 0.330
	Chrysene	< 0.330	< 0.330	< 0.330	< 0.330	0.110 J	< 0.330
	Fluoranthene	0.042 J	< 0.330	< 0.330	< 0.330	0.190 J	< 0.330
	Indeno(1,2,3-cd)pyrene	< 0.330	< 0.330	< 0.330	< 0.330	0.093 J	< 0.330
	Phenanthrene	< 0.330	< 0.330	< 0.330	< 0.330	0.093 J	< 0.330
	Pyrene	0.036 J	< 0.330	< 0.330	< 0.330	0.180 J	< 0.330

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-29
Chemical Summary Report For Surficial Soils
Site: P23
Units: UGG

Test	Site ID	E3-P23-S01	E3-P23-S01	E3-P23-S02	E3-P23-S03	E3-P23-S04	E3-P23-S05
	Field Sample ID	SDP23011	SXP23011	SXP23021	SXP23031	SXP23041	SXP23051
	Sample Date	08/31/93	08/31/93	08/31/93	08/31/93	08/31/93	08/31/93
Test	Parameter .						
TCL BNA	TCPP	0.250					
TCL Pest	Aldrin	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.001 JC
	Endosulfan Sulfate	< 0.002	< 0.002	0.002 BJU	0.009 KU!	< 0.002	0.018 C!
	Endosulfan,A	0.001 BJC	0.001 JC	0.000 BJC	0.001 BJU	< 0.002	0.010 U!
	Endosulfan,B	< 0.002	< 0.002	< 0.002	0.003 U	0.002 U	0.011 C!
	Heptachlor Epoxide	0.001 JC	0.001 JU	< 0.002	0.001 JC	< 0.002	0.002 JU!
	P,P-DDD	0.014 JU	< 0.002 J	0.004 U	0.011 C	< 0.002	0.025 C
	P,P-DDE	0.030 C	0.038 C	0.010 CK	0.005 KC	0.300 C!	0.026 C
	P,P-DDT	0.081 JC	0.150 JC	0.027 C	0.020 C	1.30 C!	0.085 C
	alpha-BHC	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.004 C
	alpha-Chlordane	0.003 C	0.003 C	0.001 JC	0.001 JC	< 0.002	< 0.002
	delta-BHC	< 0.002	< 0.002	< 0.002	0.001 JU	< 0.002	0.002 JC
	gamma-Chlordane	0.004 C	0.004 C	0.001 JC	0.001 JC	0.001 JU	0.005 C
TOC	Total Organic Carbon	12700	13500	10000	39300	18700	2940
TPHC	Total Petroleum Hydrocarbon	36.0	44.4	49.1	2300 @	78.5	15000 @

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

2.2.6 Site P26 — Air Drop Zone Clearing

Site P26 was originally identified by USAEC in 1980 as a "known or suspected location of waste material," although no mention of what, if any, material was related to Site P26. Figure 2-7 provides a site map.

2.2.6.1 Site Location

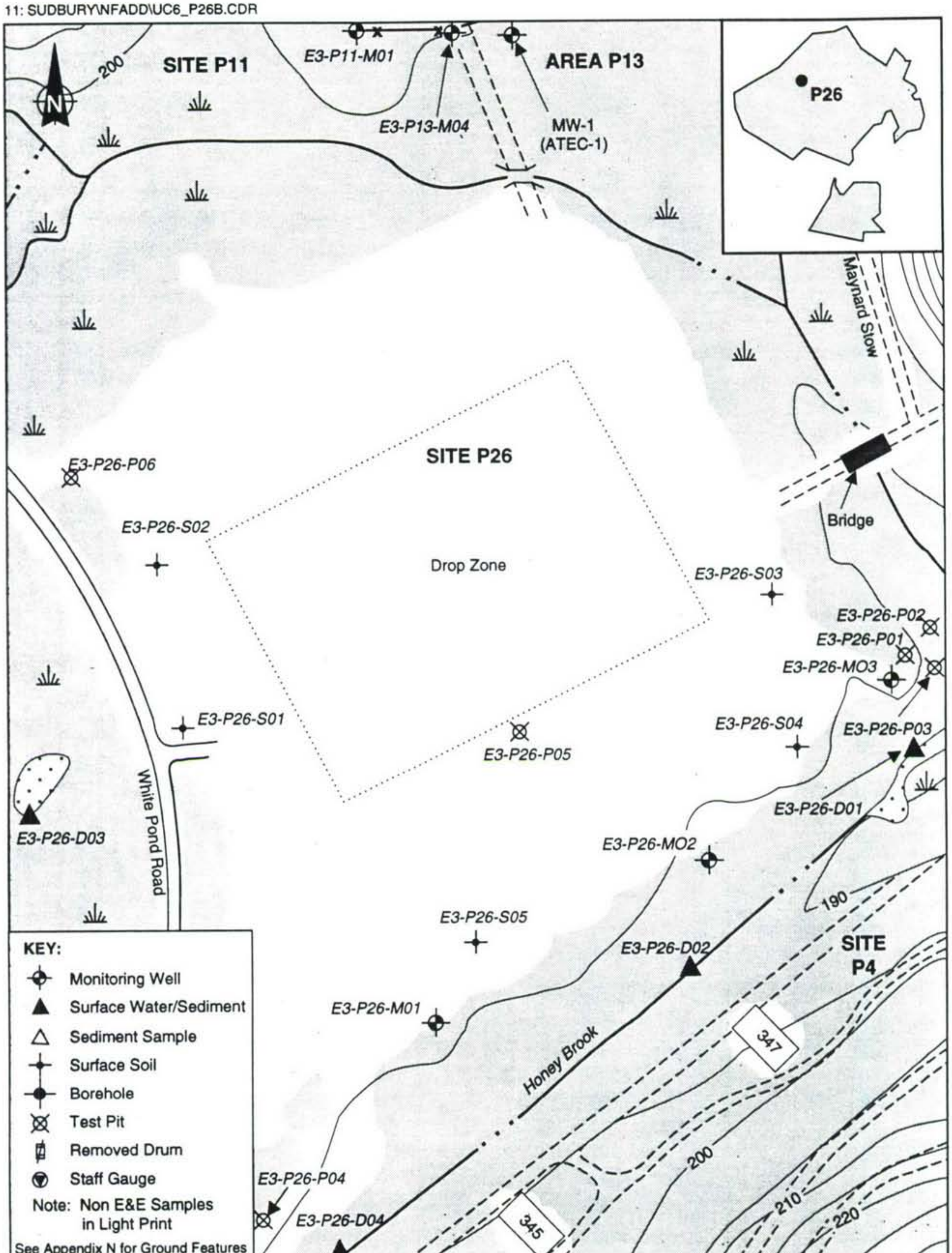
Site P26 is a large cleared area located in the central part of the Annex, and is bordered by White Pond Road to the west. The site is bounded by wetland terrain to the north and Honey Brook to the east southeast. Site P26 is accessible from the western end of the cleared zone. A sign, a parking lot, and a gate identify the entrance. The clearing is divided into three sections: a central grassy area with a flag in the middle (the actual drop zone), a cleared area on the north side, and an area covered with short brush in the south. A tributary to Honey Brook flows along the northern and eastern edge of the site. An unpaved road leads north over a culvert across this tributary to Site P13, and another across a bridge and through a gate from the eastern part of the clearing to Puffer Pond Road.

2.2.6.2 Physical Characteristics

Site P26 is located on an outwash plain of sand and gravel, entirely surrounded by wetlands or streams. The surface elevation at Site P26 is approximately 195 feet AMSL. Average groundwater elevations range from 188 to 191 feet AMSL.

Subsurface exploration at Site P26 consisted of the excavation of five test pits (E3–P25–P01 to P05) and the installation of three monitoring wells (E3–P26–P01 to P03). Test pit excavations confirmed outwash material consisting of a poorly sorted sand, silt, and gravel mixture, to 7 feet BGS. Borings at well locations E3–P26–M01 and E3–P26–M03 encountered outwash material, similar to that in the test pits from the surface to a depth of 15 feet and 18 feet, respectively. A dense gray layer of silt and fine sand, probably of glaciolacustrine origin, extended from beneath the outwash material through the remainder of the borehole length. Outwash material was observed over the entire length of the boring at well E3–P26–M02, although fine material increased with depth. All boreholes reached a total depth of 19 feet BGS. Two samples were collected from borings at each well location and submitted for grain size and Atterberg limits analyses. Soil collected from the 0 to 2 foot interval at well E3-P26-M01 was classified as moderately plastic (liquid limit 35 to 50) silty sand, while soil collected from the 4 to 6 foot interval at this location was identified as non-plastic, poorly graded sand with gravel. Samples from the 6 to 8 foot and 9 to 11 foot intervals at well E3-P26-M02 were both classified as non-plastic poorly-graded sand with silt. At well E3–P26–M03, soil samples were collected from the 1 to 2 foot and 4 to 6 foot intervals and classified as non-plastic, well graded sand with silt and gravel and non-plastic poorly grated sand, respectively. Additional geotechnical analyses were performed on five sediment samples collected at Site P26. Sediment sample E3-P26-D01 was identified as organic silt with extremely high plasticity (liquid limit 790). Samples E3-P26-D02 and E3-P26-D04 were both classified as non-plastic, poorly graded sands, while soil at E3-P26-D03

11: SUDBURY\NFADD\UC6_P26B.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 2-7 MAP OF SITE P26
AIR DROP ZONE CLEARING

was identified as silty sand with extremely high plasticity. Appendix D contains a complete summary of geotechnical results.

Slug tests were performed at each monitoring well yielding a range of transmissivity from 14.59 $feet^2$ per day to 173.71 $feet^2$ per day. Aquifer thickness used in calculations were equal to the length of the water column in each well. The very low calculated transmissivity of 14.59 $feet^2$ per day at well E3-P25-M03 can be attributed to the fact that approximately half of the screened interval is set within the dense silt and fine sand layer. Transmissivity at wells E3-P26-M01 and E3-P26-M03 are also very low. The transmissivities were calculated as follows:

$$T = Kb$$

where

T = Transmissivity ($feet^2$ per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer Thickness (feet)

Well	K	b	T
E3-P26-M01	13.19	13.17	173.71
E3-P26-M02	13.57	12.52	169.90
E3-P26-M03	1.244	11.73	14.59

Appendix G contains complete slug test data and interpretation. All transmissivity may be slightly underestimated due to conservative aquifer thickness values (less than 1,350 $feet^2$ per day). All of these values are well below the upper bound of transmissivity of low-yielding aquifers, as defined by 310 CMR 40.006 (1,350 $feet^2$ per day).

Surface water flows in all directions from Site P26 to adjacent wetlands, ultimately draining into Honey Brook and, in turn, to Taylor Brook. Based on water level data, site drainage and topography, groundwater discharges from Site P26 to wetlands in all directions when groundwater levels are high. During dry periods; however, the predominant, and perhaps only, flow direction is southeast to Honey Brook.

2.2.6.3 Ecological Characterization

This open area includes three distinct areas: the northern portion is cleared and burned, the center is vegetated with regularly mowed grass, and the southern portion is vegetated with shrubs and bushes. A dense mixture of white pine, oak, and hardwood trees ranging from 40 to 60 feet in height surrounds the site (LFS 1983).

In general, groundwater flow is to the southeast towards Honey Brook. Near the southern edge of the site there is a narrow, seasonally saturated wetland which follows Honey Brook and is vegetated with deciduous trees (USDOI 1977). In addition, immediately to the

north and west of the site, there are two seasonally saturated wetlands vegetated with deciduous trees. Near the northern forested wetland there are also two smaller semi-permanent emergent wetlands. The eastern edge of the site consists of a seasonally saturated emergent wetland which is vegetated with shrubs and deciduous trees.

In general, this area includes open area, upland forest, forested wetland, and open water wetland habitats. Disturbed open areas such as the one at Site P26 are of moderate importance to wildlife. Only rapidly growing annuals are expected to occur in the central part of the site, and due to human activity and lack of diverse vegetation, wildlife is unlikely to frequent this part of the site. The southern and the northern ends of the open area are likely to support a more diverse flora. Hence, ground nesting birds, small mammals, deer, gamebirds, and raptors may use these areas. The surrounding pine-oak forest is also likely to sustain a diverse community that includes gamebirds, songbirds, and small mammals which rely on pine seeds and acorns for much of their diet (Martin *et al.* 1951). Forested wetlands which combine nutrients, diverse woody species, and the availability of water, attract an array of aquatic species, upland species, as well as species specifically adapted to wetlands. Streams like Honey Brook and open water wetlands provide drinking water, protected sites for dens and nests, and travel routes for many species. Crustaceans, insects, plants, reptiles, amphibians, birds, and many upland species can be found in these kinds of habitats. The intermittent flow of the streams around the site restrict fish to the small bodies of open water during the driest times of the year.

Several species of concern have been reported near Site P26. A Massachusetts species of special concern, the Grass-leaved Ladies' Tress (*Spiranthes vernalis*), was observed in the northwestern corner of the site (Aneptek 1991). During the same survey, the federally endangered bald eagle (*Haliaeetus leucophalus* and the Massachusetts watch-list red-shouldered hawk (*Buteo lineatus*) were observed in the area (Aneptek 1991). No unique habitats are known to occur in the general vicinity of the site (NHESP 1992).

2.2.6.4 Site History

Site P26 consists of a clearing used by the Aero-Mechanical Engineering Laboratory of Natick Laboratories for aerial drop testing. Prior to its use as a drop zone, the area was agricultural, and several farm structures were located at the site at the time of the Army's assumption of the Annex. Structures included Buildings T447 (a hen house), and T448 (a dwelling). These buildings were destroyed around 1959. Sometime before 1967, a road was constructed to connect this area to the cluster of buildings in Site P13. A temporary building, T413, was constructed in Site P26, and was used to store smoke grenades. This structure was demolished sometime after 1978.

Site P26 was cleared to establish the Taylor Drop Zone or Taylor Testing Area in the mid-1970s. Site P26 is still used today by Natick Laboratories for testing materials through air drops from a remote-controlled ultralight drone airplane. Natick Laboratories reportedly discontinued the use of the site as a drop zone for troop (manned) drops in the mid-1970s, when the director of the Air Drop Division was killed in a low-altitude parachute drop.

2.2.6.5 Results of Previous Investigations

Section 7.35 of the *Final Site/Remedial Investigation Report* (OHM 1994) details the Phase I investigation conducted at Site P26. An enhanced area reconnaissance was conducted by OHM in 1992 at Site P26. Several small clearings and mounds were noted northwest of the drop zone. A series of pits and mounds were observed on the south edge of the drop zone in the woods along Honey Brook which is artificially excavated and labelled "Diversion Ditch" on a 1942 map of the site (E & E 1993). A metal pail was found in the stream and a pipe was sticking out of the stream bed. Partially buried metal debris and crushed drums were reportedly found on the eastern edge of the drop zone, south of the access road from Puffer Road.

2.2.6.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of geotechnical samples, were analyzed for TCL organics, TAL metals, TPHC, and herbicides on the Drinking Water Standard. One surface soil sample, three subsurface soil samples, and the sediment samples in the area were analyzed for TOC. In addition, the subsurface samples and the sediment samples were sent for geotechnical analysis to determine grain size and Atterberg limits. A summary of Phase II Sampling Activities at Site P23 is provided as Table 2–30.

Groundwater Sampling

In order to characterize groundwater quality at Site P26, the Taylor Drop Zone, E & E installed, developed, and sampled three shallow overburden monitoring wells. The three wells were all located downgradient of the drop zone area, along the southeastern edge of the clearing approximately 75 feet from Honey Brook. The wells, E3–P26–M01, E3–P26–M02, and E3–P26–M03, were placed in ascending order along Honey Brook with E3–P26–M01 completed furthest east and M03 completed furthest west. Wells E3–P26–M01 and E3–P26–M03 were screened across the water table at intervals between 8 and 18 feet BGS. Well E3–P26–M02 was screened across the water table at an interval 9 to 19 feet BGS.

Groundwater samples were collected from each of the wells during the August and December 1993 sampling events. The data provides information to assess groundwater quality and the potential for contamination to migrate through the groundwater pathway.

As a result of QA/QC protocol requirements approved in the QAPjP, E & E resampled wells E3–P26–M02 and E3–P26–M03 for volatile organics in January 1994.

Table 2-30

PHASE II SAMPLING EFFORTS AT SITE P26 — TAYLOR DROP ZONE

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	6	08/26/93 12/01/93 12/03/93 01/10/93 01/11/93	Samples were collected to investigate groundwater quality and the potential for off-site contaminant migration.
Subsurface Soils	3	08/03/93 08/04/93	Geotechnical samples were collected for grain size and Atterberg limits analyses to characterize nature of subsurface soils in the area and their impact upon the groundwater pathway.
	3	08/03/93 08/04/93	Samples were collected from the screened interval in each well to characterize the nature of the subsurface soils and assess the potential for contaminant migration in the groundwater pathway.
	3	08/03/93 08/04/93	Samples collected to TOC analysis.
	12	09/21/93	Samples were collected to investigate contamination in the subsurface soils of the area due to past site activities.
Surface Soils	5	09/14/93	Samples were collected to investigate contamination in the surface soils of the area due to past site activities.
	1	09/14/93	Sample collected for TOC analysis.
Surface Water	4	08/04/93 08/05/93 12/02/93	Samples were collected to investigate the impact of past site activities on the streams and wetlands of the area and the potential for those surface water bodies to act as future contaminant sources.
Sediment	4	08/04/93 08/05/93 12/02/93	See surface water rationale.
	4	08/04/93 08/05/93 12/02/93	Sample collected for TOC analysis.
	4	08/04/93 08/05/93 12/02/93	Geotechnical samples were collected to characterize the nature of surface soils and their impact.

Source: Ecology and Environment, Inc. 1994.

Subsurface Soil Sampling

A total of twelve subsurface soil samples were collected from six test pits located across the Taylor Drop Zone. The samples were collected at two depths from each of the six pits. The first sample was collected from an interval 1 to 2 feet BGS. The second sample was collected from a deeper interval, approximately 5 to 6 feet BGS. The subsurface investigation was performed to investigate the nature of subsurface soils and the possibility that past site activities may have caused environmental contamination to the Drop Zone area. No OVA

recordings above background were measured in any of the test pits. No unusual buried debris were identified. However, approximately five or six crushed drums were found on ground surface just inside the tree line which runs along the eastern edge of the drop zone. The drums were found near monitoring well E3-P26-M03, in the far eastern corner of the site. The drums appeared to have been crushed prior to disposal.

During monitoring well installation, samples were collected from the screened intervals in each of the wells and sent for grain size and Atterberg limits analyses. A sample was also collected from the screened interval of each of the three wells for TOC analysis. These samples provide data to assess the nature of subsurface soils in the area and their impacts upon the groundwater pathway and the potential for contaminant migration.

Surface Soil Sampling

A total of five surface soil samples were collected from five locations across the site. One surface soil sample, E3-P26-S01, was analyzed for TOC. The samples provide data to characterize surface soil contamination at the Drop Zone and assess the possibility for surface soils in the area to act as potential contaminant sources. The samples were collected near locations where maintenance activities occurred, or from areas of soil discoloration, stressed vegetation, or in surface drainage channels.

As a result of QA/QC protocol requirements, approved in the QAPjP, locations E3-P26-S02 and E3-P26-S04 were resampled and analyzed for herbicides.

Surface Water and Sediment Sampling

A total of four surface water and four sediment samples were collected from two specific areas bordering Site P26. One of the sampling locations, E3-P26-D03, is located in the wetlands area which lies west of Taylor Drop Zone. The remaining three sampling locations, E3-P26-D01, E3-P26-D02, and E3-P26-D04, all lie in Honey Brook which runs along the southeastern edge of the site. The samples were collected at evenly spaced intervals, from areas where surface water pooled, which increases the settling of suspended sediments.

All sediment samples were analyzed for TOC. Geotechnical samples were collected from the sediment sampling locations and sent for grain size and Atterberg limits analyses. The samples provide data to characterize the stream sediments, their impact upon the surface water pathway, and the potential for contaminant migration.

As a result of QA/QC protocol requirements, approved in the QAPjP, surface waters and sediments were resampled at all four sampling locations and analyzed for herbicides in December 1993.

2.2.6.7 Nature and Extent of Contamination

While Site P26 was originally identified as "a known or suspected location of waste material", the type or source of contamination suspected to be at this site has not been clarified. The only physical evidence of a potential source was the discovery of five or six crushed drums on the northeastern edge of the site.

Analysis of groundwater samples indicated levels of aluminum, iron, and manganese above screening levels in unfiltered samples from the three wells at the site. No results for aluminum and iron in filtered samples were reported due to laboratory or field contamination. Manganese was detected in the filtered samples (501 μg/L, maximum) in all three wells above the groundwater screening value of 50 μg/L (MA SMCL). A summary of detections above preliminary screening levels is provided as Table 2-31. Chemical summary tables are provided as Tables 2-32 and 2-33.

Table 2-31

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P26

Medium (Units)	Compound	Max. Background	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1] Aluminum(F)[2]	--- ---	50	MA SMCL[3]	5,500 *	E3-P26-M03	3/3
	Iron(U) Iron(F)	--- ---	300	MA SMCL	9,350 *	E3-P26-M03	2/3
	Manganese(U) Manganese(F)	--- ---	50	MA SMCL	620 501	E3-P26-M03 E3-P26-M03	3/3 3/3
SOIL (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[4]	0.522(J)[8]	E3-P26-S04	4/5
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[5] (for cons. of water & fish)	8.89	E3-P26-D01	3/4
	Iron	4,810	1,000	MA/CWA WQC (for aq. life)	1,900	E3-P26-D01	3/4
	Lead	10.3	3.2	MA/CWA WQC (for aq. life)	3.83	E3-P26-D03	1/4

See footnotes at end of table.

Table 2-31 (continued)

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P26

Medium (Units)	Compound	Max. Background	Screen Level	Source	Max. Concentration	Site ID	Frequency Above Screen Level
SED (μg/g)	Arsenic	2.03	30 6	MCP GW-1/S-1 Ontario MOE LEL[6]	35.0	E3-P26-D01	1/4 2/4
	Beryllium	0.18	0.4	MCP GW-1/S-1	1.62	E3-P26-D01	2/4
	DDD	--	0.002	NOAA ERL[7]	0.120	E3-P26-D01	4/4
	DDE	---	0.002	NOAA ERL	0.060(J)[8]	E3-P26-D01	2/4
	DDT	--	0.001	NOAA ERL	0.045 (J)	E3-P26-D01	2/4
	TPHC	16.6	2	Ontario MOE LEL	24.0(J)	E3-P26-D01	2/4

*No results reported due to laboratory or field contamination.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[5]MA CWA WQC = Massachusetts Clean Water Act Water Quality Criteria.
[6]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[7]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.
[8] J = Value is estimated.
Source: Ecology and Environment, Inc. 1994.

No organic compounds, except Δ-benzene hexachloride (0.023 μg/L) in well E3-P26-M02 in one of two rounds, and carbon disulfide (up to 10.0 μg/L) in two wells only in the December 1993 sampling round were found in groundwater sampling of three wells at P26. No screening values could be found for these compounds.

Analysis of surface soil and test pit soil samples indicated the presence of some metals slightly above background levels, but below soil screening values. Beryllium was found in surface soil at concentrations (maximum 0.522 μg/g, estimated) slightly above the soil screening value of 0.4 μg/g (MCP GW-1/S-1 soil value) and slightly above the maximum background level of 0.446 μg/g, but these detections are likely to reflect naturally occurring levels. Lead (220 μg/g, maximum) was elevated at two surface soil samples (E3-26-S01 and E3-P26-S04) above background, but was below the soil screening value of 300 μg/g (MCP GW-1/S-1 soil value). In samples taken from the five test pits, several metals were also elevate above surface soil background levels, but none were above soil screening values.

Several pesticides were detected in surface soil samples, but none at levels above the maximum detection in background soil samples. Several pesticides including endrin, endrin

aldehyde, lindane, methoxychlor, α-benzenehexachloride, and Δ-benzenehexachloride were found at trace levels below soil screening levels. TPHCs were detected in one soil sample, taken at the 1 to 2 foot interval in test pit E3-P26-P02, at 34.1 μg/g, which is well below the screening value of 500 μg/g (MCP GW-1/S-1 soil value). No other organic compounds were detected in surface soil or test pit soil samples.

Analysis of surface water samples (E3-P26-D01, E3-P26-D02, and E3-P26-D04) taken east of the site along Honey Brook indicated levels of arsenic above surface water background and screening levels. The detections of arsenic were consistent over the three samples, with the minimum detection of 7.18 μg/L at the E3-P26-D02 sample point, and the maximum of 8.89 μg/L found in the E3-P26-D01 sample taken in the backwater area of Honey Brook northeast of Site P26. The arsenic level at the most upstream sample E3-P26-D04, was higher than the sample at E3-P26-D02 which is downstream. These arsenic levels are more than twice the maximum detection in background streams (3.15 μg/L) and exceed the surface water screening value of 0.018 μg/L (MA/CWA WQC for consumption of water and fish) and the MA/CWA WQC for consumption of fish only (0.14 μg/L), but are below the WQC for the protection of aquatic life of 190 μg/L. This stream of ditch is completely unusable for water consumption and does not support fish large enough for human consumption. The pattern of surface water arsenic results seem to indicate that the arsenic source, if not natural, may not be related to Site P26. Honey Brook also receives drainage from at least six bunkers located nearby. Arsenic was detected at higher levels (13.2 μg/L) in a surface water sample taken upstream of E3-P26-D01 (but not of the other two samples taken at Site P26 in Honey Brook) along the drainage from Site P4 to Honey Brook by OHM in 1992. This surface water sample was taken to investigate run-off from a drum (now removed) at Site P4 that contaminated the soils under the drum with arsenic up to a level of 200 μg/g (OHM 1994). Arsenic was not detected above the detection limit in a surface water sample (FW1SW9) taken by OHM in 1992 at the point where the tributary from Site P11/P13 enters Honey Brook, which is downstream of sample point E3-P26-D01. Iron levels in the three samples on Honey Brook also exceeded screening values, but were well below the maximum detection in background streams.

Analysis of sediment samples from Honey Brook adjacent to Site P26, also indicated elevated levels of arsenic. However, the sediment arsenic levels increased as one proceeds downstream, with the concentration at the most upstream sample (2.15 μg/g at E3-P26-D04) being only slightly above background, increasing to 8.20 μg/g at E3-P26-D02, and then rising to a maximum of 35.0 μg/g at E3-P26-D01 taken in the ponded area of Honey Brook. The arsenic level at E3-P26-D01 exceeded the sediment screening value of 6 μg/g (Ontario MOE LEL), and also the soil screening value of 30 μg/g (MCP GW-1/S-1 soil value). At an upstream sediment sample taken by OHM in the drainage from Site P4, the maximum arsenic detection was 9.4 μg/g. Arsenic was detected at 4.9 μg/g further downstream from E3-P26-D01 in a sample (FW1SD1) taken by OHM in 1992. The maximum concentrations of other metals in the three sediment samples are also found at E3-P26-D01, with beryllium (1.62 μg/g) found at a level above the soil screening value of 0.4 μg/g (MCP GW-1/S-1).

Low levels of DDT, DDD, and DDE were detected in the samples, with the maximum detections (DDD (0.120 μg/g), DDE (0.060 μg/g), and DDT (0.045 μg/g)) found

at E3–P26–D01, exceeding the lowest effect levels used for sediment screening values for these compounds. However, the concentrations of these pesticides were well below NYSDEC SQC and EPA SQC criteria for these compounds (0.463 μg/g for DDD and DDE (NYSDEC) and 0.383 μg/g for DDT (EPA)) when they were adjusted for the site-specific TOC content of the sample at E3–P26–D01 (463,000 or 46.3 percent).

Analysis of the surface water and sediment samples (E3–P26–D03) taken in the wetland located west of White Pond Road and Site P26 and near some debris, indicated levels of lead in surface water and DDD in sediment at values above screening levels. This sample is downgradient of the debris but not of the main drop zone area of Site P26. Arsenic was found in water below the detection limit and in sediment above background, but below the screening level. The lead concentration (3.83 μg/L) in surface water at E3–P26–D03 was above the MA/CWA screening value for protection of aquatic life of 3.2 μg/L, but was below the maximum detection in background streams of 10.3 μg/L. In the sediment sample, DDD was found at a level (0.007 μg/g) slightly above the lowest effect level used for screening of 0.002 μg/g (NOAA ERL).

2.2.6.8 Conclusions and Recommendations

Sampling of soil, surface water, and groundwater at Site P26 did not identify any source of contamination at the site. In groundwater sampling at the three newly installed wells, detections of aluminum, iron, and manganese in unfiltered samples, and manganese in filtered samples were above the Massachusetts SMCLs. These metals are probably reflective of naturally occurring levels and are not thought to be site-related. No detections indicating contamination were found in surface and subsurface soil sampling at the site, including samples taken near the crushed and rusted, empty drums found near the northeastern edge of the site.

The principal residual concern at this site is the elevated concentrations of arsenic in surface water and sediment samples taken in Honey Brook that are above background and sediment screening levels. It is unknown if these arsenic levels in surface water and sediment near Site P26 are naturally occurring or are related to an anthropogenic source. The maximum arsenic detection in surface water was nearly three times the highest detection in background streams and the background pond. The maximum arsenic detection in sediments at this site was approximately 17 times the highest level in background streams, and more than three times the highest level detected in the background pond. Low levels of DDT and its breakdown products were also detected in sediments, but were below sediment criteria adjusted for site-specific TOC content. One potential source of the arsenic may be the bunkers adjacent to Honey Brook. Further investigation at Bunker 302 is designed to ascertain if bunkers at the Annex could be potential sources of more widespread arsenic contamination. Assessment of arsenic levels in stream waters and sediment, including those in Honey Brook, should take into account the results of investigations at the bunkers.

Given the results of groundwater and soil sampling at Taylor Drop Zone, which did not indicate levels of arsenic above screening values, it is unlikely that the arsenic detected in

Honey Brook are related to Site P26. No other evidence of contamination was detected at this site.

No further action at the site is recommended. The arsenic concern will be addressed in the discussion of the Taylor Brook watershed evaluation.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-32
Chemical Summary Report For Groundwater
Site: P26
Units: UGL

	Site ID	E3-P26-M01	E3-P26-M01	E3-P26-M01	E3-P26-M01	E3-P26-M01	E3-P26-M02
	Field Sample ID	MFP26011	MFP26012	MXP26011	MXP26011	MXP26012	MFP26021
	Sample Date	08/26/93	12/01/93	08/26/93	08/27/93	12/01/93	08/26/93
Test	Parameter						
TAL METAL	Aluminum	48.4 B	18.8 BJ	40.6 B		115 @	81.1 B@
	Arsenic	< 2.00	< 2.00	1.57 J		1.10 J	< 2.00
	Barium	9.20 J	< 10.0	5.89 J		< 10.0	7.22 J
	Beryllium	0.200 BJ	< 5.00	0.234 J		< 5.00	0.197 BJ
	Cadmium	< 5.00	< 5.00	< 5.00		1.24 J	< 5.00
	Calcium	7620	7130	7540		7080	5920
	Chromium	< 10.0	< 10.0	< 10.0		< 10.0	< 10.0
	Cobalt	4.88 J	< 10.0	7.07 J		< 10.0	9.01 J
	Copper	< 10.0	< 10.0	2.39 J		< 10.0	4.09 J
	Iron	60.6 B	14.6 BJ	63.5 B		123 K	81.0 B
	Lead	< 5.00	< 5.00	< 5.00		< 5.00	< 5.00
	Magnesium	616	737	511		734	584
	Manganese	87.2 @	9.62 B	81.5 @		10.9	159 @
	Nickel	14.3	< 10.0	16.7		< 10.0	< 10.0
	Potassium	2540	1950 B	2190		1930 B	1530
	Sodium	1970 KJ	3980 B	2080		3860 B	1980 KJ
	Vanadium	< 10.0	< 10.0	< 10.0		< 10.0	2.71 J
	Zinc	21.4 B	5.71 BJ	19.8 BJ		< 20.0	391
TCL Pest	delta-BHC			< 0.200		< 0.020	
TCL VOA	Carbon disulfide			< 5.00		< 5.00	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 2-32
Chemical Summary Report For Groundwater
Site: P26
Units: UGL

Test	Parameter	E3-P26-M02	E3-P26-M02	E3-P26-M02	E3-P26-M02	E3-P26-M02	E3-P26-M03
	Field Sample ID	MFP26022	MXP26021	MXP26021	MXP26022	MXP26023	MFP26031
	Sample Date	12/03/93	08/26/93	08/27/93	12/03/93	01/10/94	08/26/93
TAL METAL	Aluminum	16.8 BJ	158 @		62.4 @		31.5 B
	Arsenic	< 2.00	< 2.00 J		< 2.00		1.38 J
	Barium	7.83 J	9.79 J		7.55 J		17.6
	Beryllium	< 5.00	0.125 BJ		< 5.00		< 5.00
	Cadmium	1.24 J	1.72 J		< 5.00		< 5.00
	Calcium	6360	6150		6120		5180
	Chromium	< 10.0	2.92 J		< 10.0		< 10.0
	Cobalt	< 10.0	4.80 J		3.16 J		< 10.0
	Copper	< 10.0	< 10.0		< 10.0		< 10.0
	Iron	29.7 B	328 @		123 K		84.8 B
	Lead	< 5.00	< 5.00		< 5.00		< 5.00
	Magnesium	612	655		569		1180
	Manganese	74.0 @	172 @		73.8 @		501 @
	Nickel	< 10.0	13.1		< 10.0		< 10.0
	Potassium	< 1000	1390		< 1000		2210
	Sodium	1510 BJ	1710 KJ		1390 BJ		3710
	Vanadium	< 10.0	< 10.0		< 10.0		< 10.0
	Zinc	15.1 BJ	25.3 B		8.62 BJ		16.3 BJ
TCL Pest	delta-BHC		< 0.400		0.023		
TCL VOA	Carbon disulfide		< 5.00			10.0	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value.
K= Result bias high.

L= Result bias low.
R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Page 1 of 1
Part 3 of 3

Table: 2-32
Chemical Summary Report For Groundwater
Site: P26
Units: UGL

	Site ID	E3-P26-M03	E3-P26-M03	E3-P26-M03	E3-P26-M03	E3-P26-M03	
	Field Sample ID	MFP26032	MXP26031	MXP26031	MXP26032	MXP26033	
	Sample Date	12/03/93	08/26/93	08/27/93	12/03/93	01/11/94	
Test	Parameter .						
TAL METAL	Aluminum	32.9 B	5500 @		3530 @		
	Arsenic	< 2.00	3.22 J		1.38 J		
	Barium	9.16 J	51.6		32.9		
	Beryllium	< 5.00	0.529 BJ		0.260 J		
	Cadmium	< 5.00	< 5.00		< 5.00		
	Calcium	4280	6460		5200		
	Chromium	< 10.0	13.8		6.52 J		
	Cobalt	< 10.0	8.66 J		6.32 J		
	Copper	< 10.0	6.67 J		5.23 J		
	Iron	213 B	9350 @		6730 @		
	Lead	< 5.00	3.08 J		3.07 J		
	Magnesium	874	3160		2150		
	Manganese	358 @	620 @		434 @		
	Nickel	7.86 J	17.6		9.20 J		
	Potassium	855 J	4010		1850		
	Sodium	2830 B	4610		2940 B		
	Vanadium	< 10.0	11.3		10.2		
	Zinc	4.82 BJ	65.6 K		19.3 KJ		
TCL Pest	delta-BHC		< 0.046		< 0.020		
TCL VOA	Carbon disulfide		< 5.00			3.70 J	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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L= Result bias low.
R= Result rejected.
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@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 2-33
Chemical Summary Report For Subsurface Soils
Site: P26
Units: UGG

	Site ID	E3-P26-M01	E3-P26-M02	E3-P26-M03			
	Field Sample ID	BX2601X1	BX2602X1	BX2603X1			
	Sample Date	08/04/93	08/03/93	08/04/93			
Test	Parameter Depth	9.0 ft.	0.0 ft.	9.0 ft.			
TOC	Total Organic Carbon	25200	5270	19800			

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSO
Site Type: PIT

Table: 2-33
Chemical Summary Report For Subsurface Soils
Site: P26
Units: UGG

	Site ID	E3-P26-P01	E3-P26-P01	E3-P26-P02	E3-P26-P02	E3-P26-P03	E3-P26-P03
	Field Sample ID	EXP26011	EXP26012	EXP26021	EXP26022	EXP26031	EXP26032
	Sample Date	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93
Test	Parameter						
TAL METAL	Aluminum	5810	3830	8630	4250	5320	3830
	Antimony	< 0.500	0.498 J	0.420 J	< 0.500	< 0.500	0.392 J
	Arsenic	4.66	3.35	11.4 !	2.58 K	7.48	22.0 !
	Barium	12.2	13.6	31.2 !	15.4	15.1	15.6
	Beryllium	0.229 J	0.294 J	0.377 J	0.213 J	0.246 J	0.096 J
	Cadmium	0.188 J	< 0.500	0.579 J!	< 0.500	< 0.500	< 0.500
	Calcium	263 J	299 J	355 J	886	563 J	554 J
	Chromium	8.38	7.81	16.3 !	8.90	8.39	8.11
	Cobalt	6.59 !	3.60	5.01	3.95	3.03	4.55
	Copper	8.55	5.36	10.2	6.96	3.95	7.75
	Iron	8080	8870	14000 !	6940	8020	7350
	Lead	3.43 B	5.22 B	20.0	2.61 B	6.14 B	2.35 B
	Magnesium	1620	1190	1130	1470	1010	1410
	Manganese	161 !	86.9	92.4	58.4	43.4	65.5
	Mercury	< 0.100	< 0.100	0.105 J	< 0.100	< 0.100	< 0.100
	Nickel	10.4	6.50	7.56	9.60	6.47	9.78
	Potassium	656 !	592	357 K	866 !	265 BJ	748 !
	Thallium	0.111 J	0.109 J	< 0.500	0.083 J	0.100 J	0.115 J
	Vanadium	10.3	12.5	18.5	12.9	10.0	9.92
	Zinc	20.8 K	23.3 K	32.0	19.9 K	17.5 K	20.1 K
TCL Pest	Dieldrin	< 0.002	< 0.002	0.011 U	0.003 U	< 0.002	< 0.002
	Endosulfan Sulfate	0.001 JU	< 0.002	0.006 U	0.004 U	0.002 BJU	< 0.002
	Endrin	< 0.002	< 0.002	0.007 U	0.001 JC	< 0.002	0.000 JC
	Endrin Aldehyde	< 0.002	< 0.002	0.015 KU!	0.010 KC	< 0.002	< 0.002
	Lindane	0.001 JU	< 0.002	0.001 JC	0.001 JC	0.003 BJU	0.002 JC
	Methoxychlor	< 0.020	< 0.020	< 0.020	< 0.020	0.021 JC	< 0.020
	alpha-BHC	0.002 JC	< 0.002	0.004 U	0.003 U	0.001 BJC	0.002 JC

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 2-33
Chemical Summary Report For Subsurface Soils
Site: P26
Units: UGG

	Site ID	E3-P26-P01	E3-P26-P01	E3-P26-P02	E3-P26-P02	E3-P26-P03	E3-P26-P03
	Field Sample ID	EXP26011	EXP26012	EXP26021	EXP26022	EXP26031	EXP26032
	Sample Date	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93
Test	Parameter .						
TCL Pest	delta-BHC	0.000 BJU	< 0.002	0.002 BJC	0.001 BJU	0.001 JC	< 0.002
TPHC	Total Petroleum Hydrocarbon	< 20.0	< 20.0	34.1	< 20.0	< 20.0	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: PIT

Table: 2-33
Chemical Summary Report For Subsurface Soils
Site: P26
Units: UGG

	Site ID	E3-P26-P04	E3-P26-P04	E3-P26-P05	E3-P26-P05	E3-P26-P06	E3-P26-P06
	Field Sample ID	EXP26041	EXP26042	EXP26051	EXP26052	EXP26061	EXP26062
	Sample Date	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93
Test	Parameter .						
TAL METAL	Aluminum	7600	2340	7410	3600	5280	4610
	Antimony	< 0.500	< 0.500	< 0.500	< 0.500	0.435 J	0.272 J
	Arsenic	3.66	1.79 K	4.06	4.28	7.47	3.35
	Barium	14.6	9.42	12.2	12.0	12.1	14.9
	Beryllium	0.228 J	< 0.500	0.219 J	0.099 J	0.185 J	0.108 J
	Cadmium	< 0.500	< 0.500	0.216 J	< 0.500	< 0.500	< 0.500
	Calcium	329 J	809	313 J	563	172 J	440 J
	Chromium	12.8	4.18	8.52	5.93	8.28	8.84
	Cobalt	4.87	2.18	4.93	4.68	6.38 !	4.38
	Copper	7.28	2.72	5.11	6.44	5.92	6.47
	Iron	7530	3520	7560	6350	6420	7430
	Lead	2.27 B	1.49 B	2.96 B	3.46 B	3.24 B	3.19 B
	Magnesium	2030	890	1320	1230	1530	1760
	Manganese	72.1	39.2	112 !	157 !	168 !	64.9
	Mercury	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
	Nickel	10.7	4.67	9.57	8.41	8.37	10.2
	Potassium	769 !	668 !	535 K	503 K	665 !	859 !
	Thallium	0.076 J	< 0.500	< 0.500	< 0.500	< 0.500	0.146 J
	Vanadium	12.4	5.10	10.6	7.70	9.22	10.9
	Zinc	20.9 K	25.5	23.6 K	21.4 K	19.2 K	19.1 K
TCL Pest	Dieldrin	0.001 JU	0.004 U	0.001 JC	0.003 U	0.002 JU	0.004 U
	Endosulfan Sulfate	0.002 JC	0.006 C	0.003 U	0.003 U	0.003 C	0.004 C
	Endrin	< 0.002	0.003 C	0.000 JC	0.001 JC	0.001 JC	0.001 JC
	Endrin Aldehyde	0.004 BC	0.014 KC!	0.008 BC	0.008 BC	0.007 BC	0.010 KC
	Lindane	0.001 JC	0.001 JC	0.001 JC	0.001 JC	0.001 JC	0.001 JC
	Methoxychlor	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
	alpha-BHC	0.003 U	0.004 U	0.003 U	0.003 U	0.003 U	0.003 U

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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Table: 2-33
Chemical Summary Report For Subsurface Soils
Site: P26
Units: UGG

	Site ID	E3-P26-P04	E3-P26-P04	E3-P26-P05	E3-P26-P05	E3-P26-P06	E3-P26-P06
	Field Sample ID	EXP26041	EXP26042	EXP26051	EXP26052	EXP26061	EXP26062
	Sample Date	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93	09/21/93
Test	Parameter .						
TCL Pest	delta-BHC	< 0.002	0.001 BJU	0.001 BJU	0.001 BJU	0.001 BJU	0.001 BJU
TPHC	Total Petroleum Hydrocarbon	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
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Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-34
Chemical Summary Report For Surficial Soils
Site: P26
Units: UGG

Test	Site ID	E3-P26-S01	E3-P26-S02	E3-P26-S02	E3-P26-S03	E3-P26-S04	E3-P26-S04
	Field Sample ID	SXP26011	SXP26021	SXP26022	SXP26031	SXP26041	SXP26042
	Sample Date	09/14/93	09/14/93	12/02/93	09/14/93	09/14/93	12/02/93
Test	Parameter .						
TAL METAL	Aluminum	12600 !	11400 !		8590	9940	
	Arsenic	11.4 !	5.53		8.05	11.7 !	
	Barium	19.4	23.8		12.3	15.8	
	Beryllium	0.456 J!@	0.423 J@		0.334 J	0.522 J!@	
	Calcium	1000	912		232 J	642	
	Chromium	12.7	10.4		10.8	13.5	
	Cobalt	4.78	4.52		5.24	9.78 !	
	Copper	7.08	6.80		9.42	11.9 !	
	Iron	10700	10100		8290	38000 !	
	Lead	220 !	15.0		22.0	220 !	
	Magnesium	131400 !	1040		1440	1140	
	Manganese	79.4	94.4		91.2	157 !	
	Nickel	9.22	7.94		7.92	11.7 !	
	Potassium	429 K	330 K		565 K	379 K	
	Selenium	< 0.200 L	< 0.200		< 0.200	0.218 J	
	Sodium	144 KJ	144 KJ		180 KJ	135 BJ	
	Vanadium	17.9	16.1		13.2	22.3	
	Zinc	36.0	21.6		30.8	30.2	
TCL BNA	PADOE	0.920					
TCL Pest	P,P-DDE	0.042 C	0.049 C		0.004 C	0.036 C	
	P,P-DDT	0.042 C	0.039 C		0.004 C	0.037 C	
TOC	Total Organic Carbon	39000					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-34
Chemical Summary Report For Surficial Soils
Site: P26
Units: UGG

	Site ID	E3-P26-S05					
	Field Sample ID	SXP26051					
	Sample Date	09/14/93					
Test	Parameter						
TAL METAL	Aluminum	12000 !					
	Arsenic	9.30					
	Barium	16.0					
	Beryllium	0.442 J@					
	Calcium	746					
	Chromium	13.0					
	Cobalt	4.30					
	Copper	11.4 !					
	Iron	8740					
	Lead	24.0					
	Magnesium	1400					
	Manganese	105 !					
	Nickel	8.11					
	Potassium	420 K					
	Selenium	0.217 J					
	Sodium	161 KJ					
	Vanadium	16.4					
	Zinc	32.0					
TCL BNA	PADOE						
TCL Pest	P,P-DDE	0.008 C					
	P,P-DDT	0.022 C					
TOC	Total Organic Carbon						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 2-35
Chemical Summary Report For Surface Waters
Site: P26
Units: UGL

	Site ID	E3-P26-D01	E3-P26-D01	E3-P26-D02	E3-P26-D03	E3-P26-D04	
	Field Sample ID	WD2601X1	WX2601X1	WX2602X1	WX2603X1	WX2604X1	
	Sample Date	08/04/93	08/04/93	08/04/93	08/05/93	08/05/93	
Test	Parameter						
TAL METAL	Aluminum	322 J	443 J!	141 J	257 J	181 J	
	Arsenic	8.00 !@	8.89 !@	7.18 !@	< 2.00	7.98 !@	
	Barium	9.32 J	11.2 !	8.27 J	8.90 J	11.0 !	
	Beryllium	0.148 J	0.173 J	< 5.00	< 5.00	0.108 J	
	Calcium	5080	5110	4660	1450	4000	
	Copper	< 10.0	2.57 J	1.22 J	3.54 J	3.00 J	
	Iron	1600 #	1900 #	1100 #	918	1500 #	
	Lead	< 5.00	< 5.00	< 5.00	3.83 J#	< 5.00	
	Magnesium	941	947	930	594	994	
	Manganese	337 !	345 !	343 !	157 !	417 !	
	Potassium	1840	1960	1550	3400 !	1200	
	Sodium	3670 K	3790 K	3730 K	1150 BJ	4420 K	
	Zinc	63.1 K!	24.8 B!	17.4 BJ!	30.2 B!	5.40 BJ	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 2-36
Chemical Summary Report For Sediments
Site: P26
Units: UGG

	Site ID	E3-P26-D01	E3-P26-D01	E3-P26-D02	E3-P26-D02	E3-P26-D03	E3-P26-D03
	Field Sample ID	DX2601X1	DXP26012	DX2602X1	DXP26022	DX2603X1	DXP26032
	Sample Date	08/04/93	12/02/93	08/04/93	12/02/93	08/05/93	12/02/93
Test	Parameter .						
TAL METAL	Aluminum	4800		4600		5300 !	
	Antimony	1.21 K!		< 0.500		1.18 K!	
	Arsenic	35.0 !@#		8.20 !#		4.93 !	
	Barium	12.5		13.1		10.8	
	Beryllium	1.62 !@		0.413 J!@		0.195 J!	
	Calcium	2040 !		436 J		< 500	
	Chromium	2.96 J		6.98		9.25 K	
	Cobalt	11.4 !		5.44 !		2.11	
	Copper	7.93 !		7.72 !		12.1 !	
	Iron	6600		5800		3700	
	Lead	21.0 !		4.61 !		9.74 !	
	Magnesium	349 J		1390		996	
	Manganese	57.9		79.9 !		39.3	
	Nickel	11.9 !		10.7 !		3.12	
	Potassium	102 BJ		479 K		243 BJ	
	Selenium	0.645 !		< 0.200		< 0.200	
	Vanadium	10.5		6.55		7.96	
	Zinc	24.9 !		16.9		15.8	
TCL BNA	PHEND5			1.60			
TCL Pest	P,P-DDD	0.120 C#		0.006 JC#		0.007 JC#	
	P,P-DDE	0.060 JC#		0.002 JC		< 0.010	
	P,P-DDT	0.045 JC#		0.018 C#		< 0.010	
TOC	Total Organic Carbon	463000		21200		89400	
TPHC	Total Petroleum Hydrocarbon	19.0 J!#		< 20.0		24.0 J!#	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 2-36
Chemical Summary Report For Sediments
Site: P26
Units: UGG

	Site ID	E3-P26-D04	E3-P26-D04				
	Field Sample ID	DX2604X1	DXP26042				
	Sample Date	08/05/93	12/02/93				
Test	Parameter .						
TAL METAL	Aluminum	3900					
	Antimony	0.656 BJ!					
	Arsenic	2.15 !					
	Barium	8.90					
	Beryllium	0.344 J!					
	Calcium	< 500					
	Chromium	7.05 K					
	Cobalt	2.80					
	Copper	7.90 !					
	Iron	4200					
	Lead	9.58 !					
	Magnesium	1130					
	Manganese	39.2					
	Nickel	7.03 !					
	Potassium	386 K					
	Selenium	0.414 !					
	Vanadium	7.09					
	Zinc	12.5					
TCL BNA	PHEND5						
TCL Pest	P,P-DDD	0.023 JC#					
	P,P-DDE	0.019 JC#					
	P,P-DDT	< 0.020					
TOC	Total Organic Carbon	39600					
TPHC	Total Petroleum Hydrocarbon	< 20.0					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

2.2.7 Site P42 — Off-Site Dump

Site P42 is located just beyond the installation boundary, north of Site A1. It was originally identified by the EPA in 1982, through a review of aerial photographs. Called Site No. 1, it was described as a small dump with debris at the end of an access road. The site was apparently first used for agricultural purposes. A site map is provided as Figure 2-8.

2.2.7.1 Site Location

This site is located just outside the northern installation boundary, along the Annex property line at the intersection of Taylor Brook and an old access road or footpath that proceeds west from Taylor Road. On the north side of the path leading to the site from Taylor Road, there are several debris mounds of old, cracked asphalt. There is a cleared area along the path on an east-west axis on the west side of Taylor Brook. Logs and a piece of scrap metal obstruct the flow of Taylor Brook and create a small bridge. Gnawed tree trunks indicate beaver activity in the area. A piece of metal lies in the water on the north side of this bridge. The path continues west across the debris bridge and leads west, probably towards Patrol Road. No evidence of substantial excavation or burial of trash was observed.

2.2.7.2 Physical Characteristics

Site P42 is located on a area of recent alluvium immediately adjacent to Taylor Brook. Surface elevations at Site P42 range from 175 to 180 feet AMSL. Because the site straddles a groundwater discharge area, groundwater elevations are very shallow (less than 2 feet BGS). No subsurface exploration occurred at Site P42; however, grain size and Atterberg limits analyses were performed on surface soil sample E3-P42-S01 and sediment sample E3-P42-D01. The surface soil was identified as sandy, elastic silt, and the sediment sample was identified as silty sand. Both samples exhibited extremely high plasticity (liquid limit more than 90). Appendix D contains a complete summary of geotechnical information. Depth to bedrock is unknown. The underlying bedrock is projected to be the Gospel Hill Gneiss (Hansen 1956).

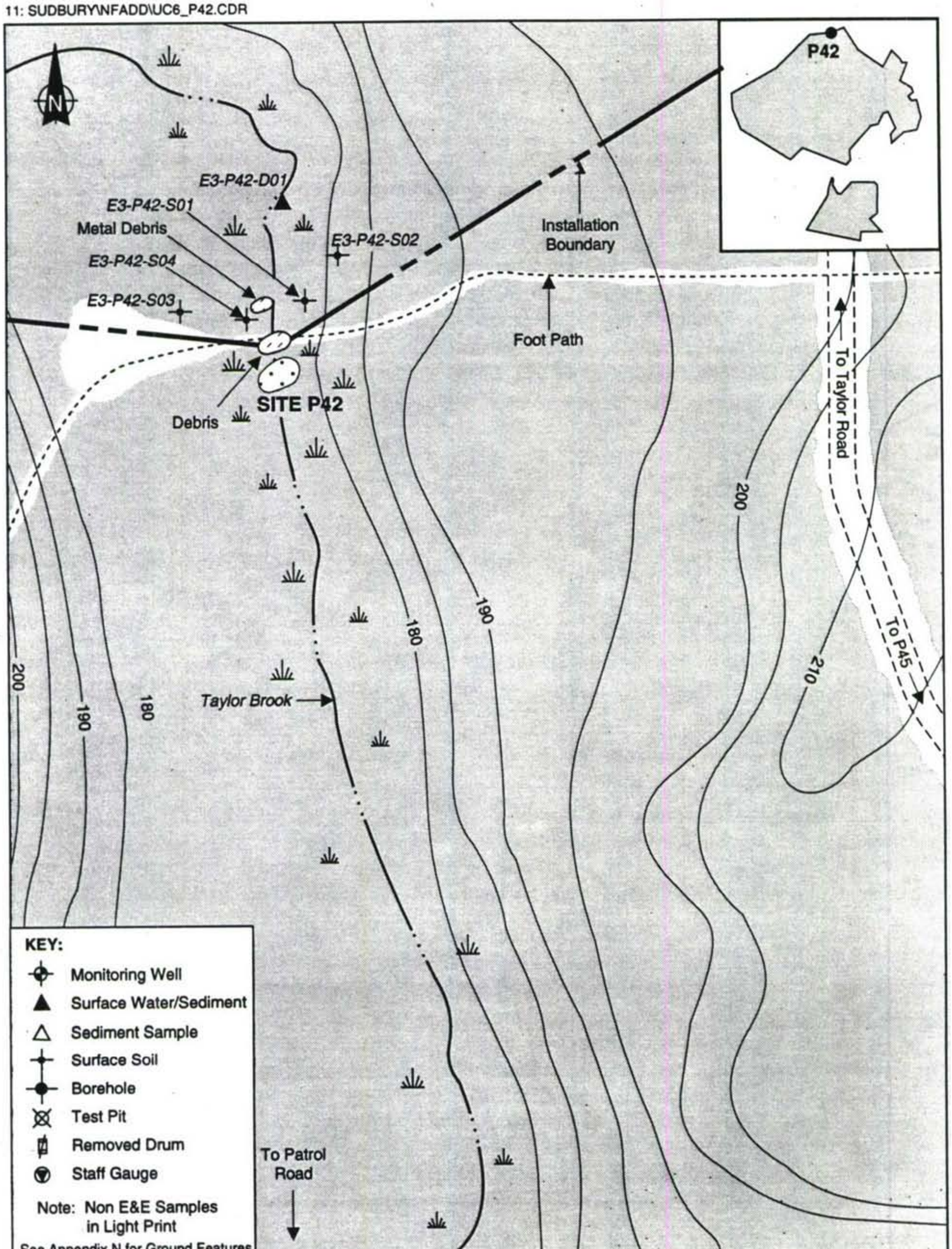
Surface water at Site P42 flows directly into Taylor Brook which empties into the Assabet River approximately 1,500 feet northwest of Site P42. Groundwater at the site also discharges immediately into Taylor Brook.

2.2.7.3 Ecological Characterization

This site is located outside the northern installation boundary at the intersection of Taylor Brook and an old footpath that runs east-west through the site. At the edge of the stream and bordering the path leading to the site, there is a mature, dense, white pine-oak forest with trees ranging from 40 to 60 feet in height (LFS 1983).

Since this site is a discharge point for groundwater and surface water, surface water runoff from the site is expected to flow directly into Taylor Brook. A narrow, seasonally saturated wetland vegetated with deciduous trees borders the stream. Fallen logs and a piece

11: SUDBURY\NFADD\UC6_P42.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 2-8 MAP OF SITE P42 OFF-SITE DUMP

of metal have obstructed the flow of Taylor brook at its intersection with the footpath and created a small pool on the southern portion of the site.

In general, this area is a mature upland forest combined with a narrow riparian wetland and a relatively fast-flowing open water stream and will attract many upland, semi-aquatic, and aquatic species. The pines and oaks provide a habitat for upland gamebirds, songbirds, and small mammals, all of which rely on pine seeds and acorns for much of their diet (Martin *et al.* 1951). The decaying oak leaves provide shelter and food to reptiles and amphibians. These species may use the wetland area and the stream. Many species of fish, crustaceans, insects, and amphibians are likely to occur in Taylor Brook and many species of upland animals are likely to use the stream for drinking water.

No unique habitats are known to occur in the general vicinity of the site (NHESP 1992). Similarly, no rare, threatened, or endangered species have been identified near the site.

2.2.7.4 Site History

The site was identified by the EPA (EPA 1982) as a possible dump, although it is unclear exactly where the site is located. Historical aerial photographs from the 1990s identify the site area as being used for agriculture. A 1949 facility map identified the area as cultivated. The water main to Maynard is noted on the 1944 map as being nearby. No roads, buildings or structures were noted on any of the facility maps found. No activity was noted for the site in any files reviewed. An aerial photograph from 1952 shows the area was cleared and accessible to Maynard residents along Taylor Road. No road accessing this area from the Annex is apparent.

2.2.7.5 Results of Previous Investigations

OHM Corporation performed an enhanced area reconnaissance of this site in 1992. The complete results of the effort are represented in the January 1994 *Final Site/Remedial Investigation* (OHM 1994).

2.2.7.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics and TAL metals. One surface soil sample and a sediment sample were also analyzed for TOC. A summary of Phase II Sampling Activities at Site P42 is provided as Table 2-37.

Table 2-37

PHASE II SAMPLING EFFORTS AT SITE P42 — OFF-SITE DUMP

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	4	08/03/93	Samples were collected to investigate surface soil contamination in the area and the potential for the soils to act as future contaminant sources.
	1	08/03/93	Sample collected for TOC analysis.
	1	08/03/93	A geotechnical sample was collected to determine the nature of the soil in the area.
Surface Water	1	08/03/93	Surface water and sediment samples were collected to investigate the impact of past site activities upon Taylor Brook and characterize surface water quality of the stream as it leaves the Annex.
Sediment	1	08/03/93	See surface water rationale.
	1	08/03/93	Sample collected for TOC analysis.
	1	08/03/93	A geotechnical sample was collected to determine the nature of the soil in the area.

Source: Ecology and Environment, Inc. 1994.

Surface Soil Sampling

A total of four surface soil samples were collected from areas surrounding the suspected off-site dump to characterize the nature of surface soil contamination. Samples were collected from areas with soil discoloration, distressed vegetation, or from areas lying in surface drainage channels. The samples will investigate the possibility that the area surface soils will act as future contaminant sources. Sample E3-P42-S01 was analyzed for TOC.

Surface Water and Sediment Sampling

One surface water and one sediment sample were collected from Taylor Brook in an area downstream of the suspected dump (E3-P42-D01). The samples were added to the original site sampling plan to characterize the surface water quality of Taylor Brook as it leaves the Annex property prior to convergence with the Assabet River. The data will help assess the impact of past site activities at Site P42 upon Taylor Brook and investigate the potential for off-site contaminant migration.

A geotechnical sample was were collected from the surface water and sediment sampling location E3-P42-D01 and sent for grain size and Atterberg limits analyses. The samples provide data to characterize the stream sediments, their impact upon the surface water pathway and the potential for contaminant migration.

2.2.7.7 Nature and Extent of Contamination

Analysis of surface soil samples taken at Site P42 did not indicate any evidence of site-related contamination. The only compound detected at a level above soil screening values was beryllium (a maximum of 0.501 μg/g) slightly above the maximum detection in background samples (0.446 μg/g), and the screening value of 0.4 μg/g (MCP GW-1/S-1 soil value). While several other metals were found at levels above background in soils samples at this site, none were above soil screening values. Some low levels of PAH compounds were detected in E3-P42-S01 perhaps as the result of fires, but all were below soil screening values. Lindane, DDT, DDD, and DDE were detected at levels above the maximum detections of these pesticides in background soils in several soil samples, with the highest detections at E3-P42-S04. None of the concentrations detected were above soil screening values. These levels are likely the results of historic pest-management practices, either at the Annex or the off-site areas near Site P42. A summary of detections above preliminary screening levels at Site P42 is presented as Table 2-38. Chemical summary tables are provided at the end of this site's discussion in Tables 2-39, 2-40, and 2-41.

Table 2-38

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P42

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
SOIL (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[1]	0.501(J)[4]	E3-P42-S01	2/4
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[2] (for cons. of water and fish)	8.42	E3-BCK-D01	1/1
	Iron	4,810	1,000	MA/CWA WQC (for aq. life)	2,500	E3-BCK-D01	1/1
	Lead	10.3	3.2	MA/CWA WQC (for aq. life)	3.99	E3-BCK-D01	1/1
SED (μg/g)	DDD	---	0.002	NOAA ERL[3]	0.037	E3-BCK-D01	1/1
	DDE	---	0.002	NOAA ERL	0.013(J)	E3-BCK-D01	1/1
	DDT	---	0.001	NOAA ERL	0.013(J)	E3-BCK-D01	1/1

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[2]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria.
[3]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range Low.
[4]Value is estimated.

Source: Ecology and Environment, Inc. 1994.

One potential concern identified in surface water samples taken at Site P42 was the detection of arsenic in surface water at 8.42 μg/L, which is above background levels, and above the MA/CWA WQC for consumption of fish and water (0.018 μg/L) and the WQC for consumption of fish alone (0.14 μg/L). The arsenic level was well below the WQC for the protection of aquatic life (190 μg/L). Iron and lead were detected in the surface water sample at levels above the WQCs for protection of aquatic life, but were well below the maximum detection in background streams at the Annex.

In the sediment sample taken at Site P42, arsenic was elevated (4.72 μg/g) above background (2.03 μg/g, maximum), but was below the sediment screening value of 6 μg/g (Ontario MOE LEL). DDT (0.013 μg/g) and its breakdown products DDD (0.013 μg/g) and DDE (0.037 μg/g) were found at levels above background and above the NOAA ERL values used for screening for DDT (0.001 μg/g), and for DDD and DDE (both 0.002 μg/g). However, none of these compounds were above NYSDEC or EPA sediment quality criteria for DDT (EPA, 0.109 μg/g), DDD and DDT (NYSDEC, both 0.132 μg/g) that were adjusted for the TOC content of the sediment sample (132,000 μg/g or 13.2 percent). Given that the NYSDEC and EPA criteria are derived using a site-specific organic carbon parameter, it is likely that these criteria are more appropriate than the LEL levels which are not site-specific. Fluoranthene (0.084 μg/g, estimated) and pyrene (0.110 μg/g, estimated) were found but were below sediment screening values.

2.2.7.8 Conclusions and Recommendations

Only a small amount of physical debris was found at Site P42, which was originally identified by aerial photography. Analysis of surface soil samples taken at this site did not indicate any evidence of contamination of soils at the site. DDT and its degradation products DDD and DDE were found in the sediment sample at a level above the lowest effect levels for benthic organisms used for screening (NOAA ERL criteria), but below NYSDEC and EPA SQC that were adjusted on a site-specific basis for total organic carbon content. In the surface water sample, iron and lead were detected above ambient water quality criteria for the protection of aquatic life, but below the maximum detections of iron and lead in background streams at the Annex.

The one detection of concern at Site P42 is arsenic in the surface water at a concentration of 8.42 μg/L, which is more than twice the highest detection of arsenic in background streams or the background pond. This concentration is above Massachusetts/CWA AWQC for the protection of water for consumption of water and fish and for the consumption of fish only. However, the concentration in the water sample at Site P42 is below the AWQC for the protection of aquatic life.

Field investigations did not identify any contaminants in soils directly around the debris at Site P42. Sediment samples contained several pesticides, but the likely source is general past spraying practices at the Annex. The arsenic detected in surface water is unlikely to be related to the debris at this site. Given that arsenic has been detected in surface water and sediment samples taken upstream in Taylor Brook at levels above background, the potential source of arsenic is probably upstream (if the arsenic is not due to naturally

occurring levels of this metal). Ongoing investigation of Taylor Brook and potential arsenic sources at the Annex should take into account the arsenic result at this site. At Site P42 itself, there does not appear to be any sign of site-related contamination and no further action is recommended.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-39
Chemical Summary Report For Surficial Soils
Site: P42
Units: UGG

	Site ID	E3-P42-S01	E3-P42-S02	E3-P42-S03	E3-P42-S04		
	Field Sample ID	SX4201X1	SX4202X1	SX4203X1	SX4204X1		
	Sample Date	08/03/93	08/03/93	08/03/93	08/03/93		
Test	Parameter						
TAL METAL	Aluminum	10000	6500	5200	10000		
	Arsenic	10.2 !	11.8 !	12.3 !	5.92		
	Barium	53.1 !	20.9	14.5	19.6 J		
	Beryllium	0.501 J!@	0.333 J	0.319 J	0.455 J!@		
	Calcium	1500 !	1320 !	766 J	< 500		
	Chromium	18.9 !	12.0	12.5	10.1		
	Cobalt	5.78	4.25	4.30	4.98		
	Copper	31.7 !	15.6 !	11.7 !	18.2 !		
	Iron	12000	11000	13000 !	4480		
	Lead	250 !	77.0	98.0	220 !		
	Magnesium	1760	1450	443 J	886 J		
	Manganese	79.1	55.3	20.4	27.3 J		
	Mercury	0.249	< 0.100	< 0.100	< 0.100		
	Nickel	15.0 !	9.37	8.59	9.81		
	Potassium	526 K	396 KJ	388 KJ	400 KJ		
	Selenium	0.705 !	0.650 !	0.987 !	1.79 !		
	Vanadium	24.3	21.3	21.7	15.9		
	Zinc	59.9 !	26.6	17.4	32.0		
TCL BNA	Benzo(a)anthracene	0.170 J	< 0.330	< 0.330	< 0.330		
	Benzo(a)pyrene	0.180 J	< 0.330	< 0.330	< 0.330		
	Benzo(b)fluoranthene	0.230 J	< 0.330	< 0.330	< 0.330		
	Chrysene	0.210 J	< 0.330	< 0.330	< 0.330		
	Fluoranthene	0.330 J	< 0.330	0.200 J	0.360 J		
	LINOLA			0.350			
	Phenanthrene	0.120 J	< 0.330	< 0.330	< 0.330		
	Pyrene	0.340 J	< 0.330	0.170 J	0.270 J		
TCL Pest	Lindane	< 0.010	< 0.010	< 0.020	0.029 JC!		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-39
Chemical Summary Report For Surficial Soils
Site: P42
Units: UGG

	Site ID	E3-P42-S01	E3-P42-S02	E3-P42-S03	E3-P42-S04		
	Field Sample ID	SX4201X1	SX4202X1	SX4203X1	SX4204X1		
	Sample Date	08/03/93	08/03/93	08/03/93	08/03/93		
Test	Parameter .						
TCL Pest	P,P-DDD	0.032 JC	< 0.020	< 0.040	0.110 C!		
	P,P-DDE	0.140 C!	0.075 C	0.170 C!	0.230 C!		
	P,P-DDT	< 0.020	< 0.020	0.120 C	0.130 C		
TOC	Total Organic Carbon	147000					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 2-40
Chemical Summary Report For Surface Waters
Site: P42
Units: UGL

	Site ID	E3-P42-D01					
	Field Sample ID	WX4201X1					
	Sample Date	08/03/93					
Test	Parameter .						
TAL METAL	Aluminum	197 J					
	Arsenic	8.42 !@					
	Barium	11.0 !					
	Calcium	6280					
	Iron	2500 #					
	Lead	3.99 J#					
	Magnesium	1270					
	Manganese	109					
	Potassium	1200					
	Sodium	7810					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 2-41
Chemical Summary Report For Sediments
Site: P42
Units: UGG

	Site ID	E3-P42-D01					
	Field Sample ID	DX4201X1					
	Sample Date	08/03/93					
Test	Parameter .						
TAL METAL	Aluminum	2700					
	Arsenic	4.72 !					
	Barium	10.6					
	Beryllium	0.098 J					
	Calcium	827 !					
	Chromium	4.03					
	Cobalt	1.47 J					
	Copper	7.57 !					
	Iron	2700					
	Lead	30.0 !					
	Magnesium	555 J					
	Manganese	35.5					
	Nickel	2.90					
	Selenium	0.319 !					
	Vanadium	6.15					
	Zinc	15.2					
TCL BNA	Fluoranthene	0.084 J					
	Pyrene	0.110 J					
TCL Pest	P.P-DDD	0.037 C#					
	P.P-DDE	0.013 JC#					
	P.P-DDT	0.013 JC#					
TOC	Total Organic Carbon	132000					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

2.2.8 Site P45 — Burned Area by Outside Fence

Site P45 was initially discovered through an EPA review of aerial photographs in 1982 that identified a potentially burned area containing dead trees. Subsequent reconnaissance by OHM in 1991 also located a drum south of the burned area and a depression containing a small amount of metal debris east of the burned area. Figure 2-9 provides a site map.

2.2.8.1 Site Location

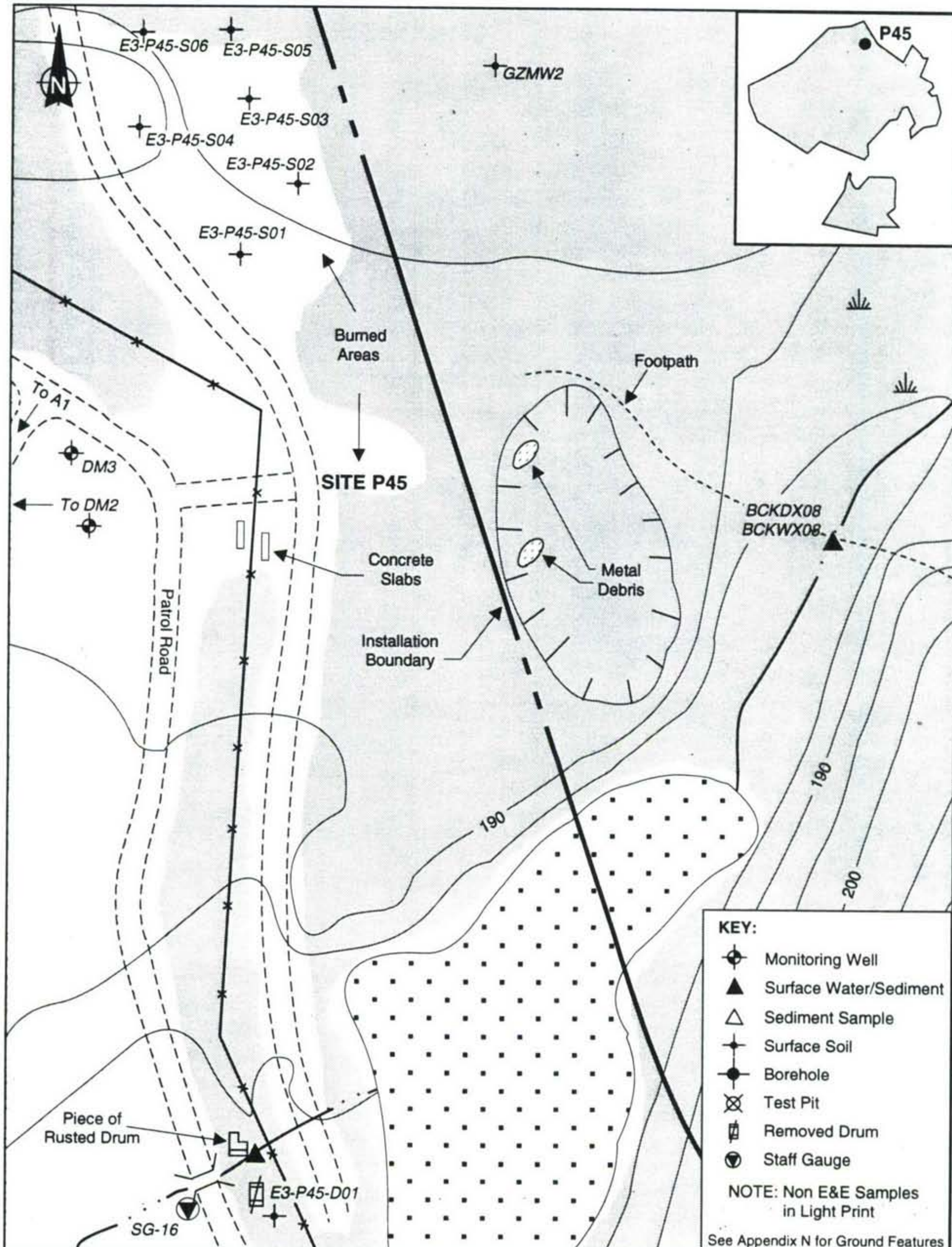
This area is situated on the northern end of the Annex and on the eastern side of Patrol Road. Some of Site P45 is outside the security fence, and one area is outside the current installation boundary. Site P45 lies between Patrol Road to the west and a tributary to Taylor Brook, which bounds the site's eastern and southern end. An old road exiting from Patrol Road to the site has been blocked by an earthen berm in front of a former gate. Several prefabricated concrete blocks lie to the right of this gate near the fence. Past the wire fence an old dirt road heads north, into a forested area, and south, parallel to Patrol Road. Most of the area is covered with forest. Approximately 100 feet east of the gate, and into the forest, there is a large depression with a series of smaller depressions within it. A small amount of metal debris, including some household items such as bed springs, is scattered near some of these depressions. Further east, past the large area with depressions, is a path which, if followed south, leads over a log bridge crossing the tributary to Taylor Brook.

Several burn areas are located along the dirt road north of the gate. The largest of the burn areas is 200 feet west of well GZA–MW2. South of the gate, along the dirt road, there is a small burn area with apparent successional vegetation. Further south the old road narrows into a trail and crosses a culvert. This culvert carries water from the tributary to Taylor Brook and from a nearby pond (located across Patrol Road) to Taylor Brook. A piece of a rusted drum was found in the stream between the fence and Patrol Road. A drum was also found near this point by OHM in 1992.

2.2.8.2 Physical Characteristics

Site P45 is located on a kame terrace of sand and gravel. Surface elevations at the site range from 190 to 196 feet AMSL. Average groundwater elevation at monitoring well GZA–MW2, upgradient of the site, is 186 feet AMSL. Geotechnical information and observation collected during the installation of well GZA–MW2 by GZA, Inc. in 1990 show well-sorted layers of sand and silty sand, typical of kame terrace stratigraphy. Depth to bedrock is unknown, but the underlying formation is projected to be Gospel Hill Gneiss (Hansen 1956). A surface soil sample (E3-P45-S04) and a sediment sample (E3-P45-D01) collected at Site P45, were submitted for grain size and Atterberg limits analyses. The surface soil was identified as silty sand with low plasticity (liquid limit less than 35) and the sediment was identified as non-plastic, poorly graded sand. Appendix D contains a complete summary of geotechnical results.

11: M:\SUDBURY\UC6_P45.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 2-9 MAP OF SITE P45
BURNED AREA BY OUTSIDE FENCE

Surface water flows south and southwest from Site P45 into a wetland and a small pond connected to Taylor Brook by an unnamed stream. No hydrogeological data was collected at Site P45, but based on drainage and topography, groundwater flows either west to Taylor Brook or south into the small pond and associated stream.

2.2.8.3 Ecological Characterization

The clearings, old burn areas currently revegetating with grasses and forbs, are located in the northern portion of Site P45. The forest in the northern portion of the site consists of young white pine and hardwood trees, while more mature white pine and oak trees, ranging from 40 to 60 feet in height, occur in the southern part of the site (LFS 1983).

Groundwater from the burn areas flow west to Taylor Brook. At the south end of the site adjacent to the west flowing tributary to Taylor Brook, groundwater flow is towards the tributary and to the small pond formed by damming this stream. Along the eastern and southern side of the area where Site P45 is located there is a seasonally saturated forested wetland of deciduous trees that lines the tributary to Taylor Brook. On the southern end of this wetland, there is a pond, and a seasonally-saturated, scrub/shrub wetland that extends to Taylor Creek (USDOI 1977).

This area includes four distinct habitats: open area, upland forest, forested wetland, and open water wetland. Open areas undergoing field succession and surrounded by forest edge support a variety of wildlife including many species of ground nesting birds, small mammals, gamebirds, and raptors. Forests such as the one covering the majority of the site are also very valuable to wildlife. Pine seeds, oak acorns, twigs, buds and flowers are food for many species of songbirds, upland gamebirds, small mammals, and deer (Martin *et al.* 1951). The pines' dense canopy closure is shelter to many species, particularly during the winter. Forested and open water wetlands are also of great value to wildlife because they combine many species of woody plants, the abundance of water, and food. Such wetlands support many semi-aquatic and aquatic species, and also attract upland species.

A spotted turtle (*Clemmys guttata*), a Massachusetts species of special concern, was observed in the small pond on the southern part of the site (Butler 1992). No unique habitats are known to occur in the general vicinity of the site (NHESP 1992).

2.2.8.4 Site History

Site P45 consists of several distinct areas including a burned area, a depression containing metal debris, and an area along a small stream that formerly contained a drum. The area was initially identified by aerial photographs (EPA 1982). In 1952, an aerial photograph shows the area as partially cleared and partially vegetated. A clearing and possibly disrupted ground were observed in a 1978 aerial photograph.

The 1944 facility map notes that an old farm road passes the area leading through a gate onto the Annex. The 1955 facility map shows Gate G-12 at the corner in the Annex fenceline. This gate apparently controlled access onto the Annex from the old farm road.

The 1967 facility map also shows this gate but also notes a second road that branches off the road from Maynard and enters the rear portion of the site, where metal debris was found. Concrete slabs, possibly part of a sentry structure at the gate, are still present at Site P45. No other references to structures or historical activity at Site P45 were discovered. The drum found along the small stream was removed in 1992.

2.2.8.5 Results of Previous Investigations

Investigations at Site P45 through 1991 have been described more fully in Section 7.54 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994).

In 1985, Dames and Moore, USATHAMA, Fort Devens, and the MADEQE surveyed Site P45 and reported that the site appeared to have been burned and is currently revegetating.

In 1991, a more detailed site reconnaissance was performed by OHM as part of their Phase I SI. A drum was discovered on the southern end of the site. Other nearby wells sampled included DM2 and DM3, both located west and downgradient of Site P45. No unusual results from wells DM2 or DM3 were reported except a trace of carbon disulfide (2.7 μg/L) in the field duplicate from well DM3 in the June 1992 sampling round. This analyte was not found in the October 1992 sampling. One of the facility-wide monitoring wells GZA (MW2) was redeveloped and sampled. This well is immediately upgradient of part of Site P45 (the burn areas). Unknown BNAs were noted and N,N-diethyl-3-methylbenzamide (120 μg/L), as well as several metals. Apart from calcium, potassium, and sodium, these were manganese (11.5 μg/L) and zinc (57.5 μg/L), which are evidently background levels.

Removals

OHM removed the drum located east of Patrol Road next to the installation fence and staged it at Site P13. A confirmatory soil sample (P45CD1) was taken and analyzed for TCL volatile and semivolatile organic compounds, TCL pesticide/PCBs, TAL metals, and explosives.

Two PAHs, chrysene (0.22 μg/g), and fluoranthene (0.28 μg/g), were detected in P45CD1. These two compounds are often present in burn areas, and could confirm burning activities at Site P45. The only metals detected above background levels were arsenic (260 μg/g) and potassium (580 μg/g). The concentration of arsenic was the highest found at the Annex up to that time and may be indicative of local contamination possibly from arsenic-based herbicides that may have been contained in the drum.

2.2.8.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics and TAL metals. All surface soil

samples and the sediment sample collected at the site were analyzed for TOC. One surface soil sample and the sediment sample were sent for geotechnical analysis to determine grain size and Atterberg limits. In addition, the surface water and sediment samples were analyzed for TPHC. A summary of Phase II Sampling Activities at Site P45 is provided as Table 2–42.

Table 2-42

PHASE II SAMPLING EFFORT AT SITE P45 — BURNED AREA BY OUTSIDE FENCE

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	6	09/01/93 09/15/93 11/30/93	Samples were collected to investigate contamination in the surface soils of the area and the potential for the area soils to act as contaminant sources.
	6	09/01/93 09/15/93 11/30/93	Samples collected for TOC analysis.
	1	09/01/93	A geotechnical sample was collected at local E3-P45-S04 to characterize the nature of soils.
Surface Water	1	09/20/93	Samples were collected to characterize stream quality and determine whether past site activities have impacted the wetlands area downgradient and south of P45.
Sediment	1	09/20/93	See surface water sampling rationale
	1	09/20/93	Samples collected for TOC analysis.
	1	09/20/93	A geotechnical sample was collected at local E3-P45-S04 to characterize the nature of soils.

Source: Ecology and Environment, Inc. 1994.

Surface Soil Sampling

A total of six surface soil samples were collected from locations interspersed throughout the large clearing suspected of previously being used for the burning of unknown wastes. All samples were analyzed for TOC and sample E3-P45-S04 was also analyzed for grain size and Atterberg limits. The samples provide data to characterize the area surface soils and the potential for the soils to act as contaminant sources.

As a result of the QA/QC protocols approved in the QAPjP, all six sampling locations were resampled in September and November 1993 and analyzed for volatile organics, pesticides and PCBs.

Surface Water and Sediment Sampling

One surface water and one sediment sample were collected from an area downgradient of Site P45 to characterize surface water quality of the stream prior to its convergence with Taylor Brook. The sampling location, E3–P45–D01, was chosen downgradient of a partially submerged drum and downgradient of an oily sheen discovered during an inspection of the site and surrounding area. Due to the discovery of the sheen the

analytical parameter TPHC was added to the sampling plan for Site P45. The sampling location lies east of Patrol Road, downstream of the pond and wetlands area which are located just off of Annex property.

Sample E3-P45-D01 was analyzed for TOC. In addition, a geotechnical sample was collected from the same surface water and sediment sampling location and sent for grain size and Atterberg limit analyses. The samples provide data to characterize the stream sediments, their impact upon the surface water pathway and the potential for contaminant migration.

2.2.8.7 Nature and Extent of Contamination

Analysis of surface soil samples taken in a suspected burn area at Site P45 indicated the presence of several metals in concentrations above background including aluminum, beryllium, chromium, lead, and manganese. While beryllium (maximum of 0.493 μg/g, estimated) was above the soil screening value of 0.4 μg/g (MCP GW-1/S-1), it was only slightly above the maximum detection in background soils (0.446 μg/g), and probably reflects naturally occurring levels. The only other metal detected above soil screening values was lead (310 μg/g) in one sample (E3-P45-S03). This was the only detection of lead above background at the site and is slightly above the soil screening value of 300 μg/g (MCP GW-1/S-1), but below the MCP GW-3/S-3 value of 600 μg/g and below the EPA Interim Soil Cleanup Level for Lead at Superfund sites of 500 μg/g. A summary of detections above preliminary screening levels is provided in Table 2-43. A summary of analytical results are provided in Tables 2-44, 2-45, and 2-46.

One pesticide was detected in one soil sample (E3-P45-S02) at Site P45 in concentrations above maximum detections in background. While β-endosulfan (0.006 μg/g) was found above background, it was found at a concentration below the soil screening values of 0.2 μg/g (MCP GW-1/S-1). Other pesticides were also detected at trace levels in soil samples taken at the site, but none were above corresponding maximum detections in background soils. No VOCs were detected in any of the soil samples taken at the site.

Surface water and sediment samples were taken downstream of the wetland and pond (sample point E3-P45-D01) that are likely to receive surface runoff from Site P45. Background surface water and sediment samples (E3-BCK-D08) were also taken upstream of the wetland and pond as part of the facility-wide assessment. Arsenic was found in the Site P45 samples at levels above the background samples and screening values in both surface water and sediment. Arsenic was detected in surface water at 106 μg/L, which is significantly above the detection in the background sample (1.96 μg/L), and above the MA/CWA WQC for consumption of fish and water (0.018 μg/L) and the WQC for consumption of fish only (0.14 μg/L). This detection was just over half of the WQC for protection of aquatic life of 190 μg/L. Lead was also detected in surface water at 6.20 μg/L, which is above the WQC for protection of aquatic life of 3.2 μg/L but is below the detection in the background sample of 10.3 μg/L. Iron was also found in the surface water sample at a level (7,180 μg/L) above background (4,810 μg/L) and the WQC for protection of aquatic life of 1,000 μg/L.

Table 2-43

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P45

Medium (Units)	Compound	Maximum Background	Screen Level	Source	Max. Concentration	Site ID	Frequency Above Screen Level
SOIL (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[1]	0.493(J)[4]	E3-P45-S06	5/6
	Lead	150	300	MCP GW-1/S-1	310	E3-P45-S03	1/6
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[2] (for cons. of water and fish)	106	E3-P45-D01	1/1
	Iron	4,810	1,000	MA/CWA WQC (for Aq. Life)	7180	E3-P45-D01	1/1
	Lead	10.3	3.2	MA/CWA WQC (for Aq. Life)	6.20	E3-P45-D01	1/1
SED (μg/g)	Arsenic	2.03	6	Ontario MOE LEL[3]	19.0	E3-P45-D01	1/1

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[2]MA CWA WQC = Massachusetts Clean Water Act Water Quality Criteria.
[3]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[4] J = Value is estimated.

Source: Ecology and Environment, Inc. 1994.

The only compound detected above sediment screening values in the P45 sediment sample was arsenic at 19.0 μg/L, which is above the detection in the background sample (1.22 μg/g), and the screening value of 6 μg/g (Ontario MOE LEL), but below the NOAA ERM level of 85 μg/g.

2.2.8.8 Conclusions and Recommendations

This site was originally identified by the EPA because of the presence of several clearings, which were suspected to be burned areas. Subsequent reconnaissance also referred to these clearings as potential burn areas. No activity has been identified that might be the cause of these clearings. Whether these clearings are the result of fires or not, soil sampling at one of the clearings at the site did not identify any evidence of contamination. The lead level detected in one soil sample slightly exceeded the most conservative soil screening level (MCP GW-1/S-1), but was well below the EPA interim cleanup level for lead. While the other clearings at Site P45 have not been sampled, given the lack of debris in the clearings and the results of sampling at the first clearing, it is unlikely that contamination exists in these other clearings. It is recommended that no further action be conducted concerning the clearings at Site P45.

Arsenic detected in surface water and sediment sampling on the unnamed tributary to Taylor Brook possibly reflects residual local contamination related to a drum removed from near the sampling point. Arsenic was not elevated in soil samples taken at one of the clearings at Site P45. A soil drum confirmation sample (P45CD1) taken by OHM in 1992 after removal of a drum adjacent to the small stream indicated a residual level of arsenic of 260 μg/g. The location of this drum was approximately 60 feet southeast of where E & E took surface and water samples, and runoff from the former drum location enters the stream that flows under Patrol Road at the sampling point. The sampling results may also be related to a piece of metal debris immediately upstream of the sample point that appears to be the remains of a drum.

The removal of soil around the former drum location is likely to reduce residual risk at this site, but the extent of arsenic in the small tributary to Taylor should be investigated. The specific recommended scope of work is listed below:

- Surface water and sediment sampling upstream of the former drum location at the exit point from the small pond, at the culvert that crosses under Patrol Road, and downstream in the small stream before it enters Taylor Brook;

- Removal of soil in the area around the former drum location where OHM detected elevated levels of arsenic; and

- Confirmatory soil sampling at the soil removal location.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S01	E3-P45-S01	E3-P45-S01	E3-P45-S01	E3-P45-S01	E3-P45-S01
	Field Sample ID	SDP45011	SDP45011	SDP45012	SXP45011	SXP45011	SXP45012
	Sample Date	09/01/93	09/15/93	11/30/93	09/01/93	09/15/93	11/30/93
Test	Parameter						
TAL METAL	Aluminum	10600 !			12000 !		
	Arsenic	5.98			5.42		
	Barium	18.4			21.0		
	Beryllium	0.408 J@			0.445 J@		
	Calcium	237 J			245 J		
	Chromium	16.4 !			17.8 !		
	Cobalt	4.65			5.15		
	Copper	7.44			8.39		
	Iron	9580			10300		
	Lead	14.0			17.0		
	Magnesium	1500			1560		
	Manganese	134 !			150 !		
	Mercury	< 0.100			0.133		
	Nickel	8.82			9.16		
	Potassium	306 K			335 K		
	Selenium	0.321			0.347		
	Vanadium	15.0			16.0		
	Zinc	23.4 J			20.4 J		
TCL BNA	1DTCTL	2.10					
	C16AME				0.077		
	EMLIN				0.140		
	PADOE						
	ZMLIN						
TCL Pest	Aldrin		< 0.002			0.001 BJC	
	Dieldrin		< 0.002			0.002 JU	
	Endosulfan,A		0.001 BJC			< 0.002	
	Endosulfan,B		0.001 JU			0.003 JU	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S01	E3-P45-S01	E3-P45-S01	E3-P45-S01	E3-P45-S01	E3-P45-S01
	Field Sample ID	SDP45011	SDP45011	SDP45012	SXP45011	SXP45011	SXP45012
	Sample Date	09/01/93	09/15/93	11/30/93	09/01/93	09/15/93	11/30/93
Test	Parameter						
TCL Pest	Endrin		0.001 BJC			0.005 KC	
	Endrin Aldehyde		< 0.002			< 0.002	
	Heptachlor Epoxide		< 0.002			0.001 JU	
	P,P-DDD		0.003 JU			0.012 JU	
	P,P-DDE		0.007 C			0.007 C	
	P,P-DDT		0.005 JC			0.010 JC	
	alpha-BHC		< 0.002			< 0.002	
	beta-BHC		< 0.002			< 0.002	
TOC	Total Organic Carbon	32500			49200		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S02	E3-P45-S02	E3-P45-S02	E3-P45-S03	E3-P45-S03	E3-P45-S03
	Field Sample ID	SXP45021	SXP45021	SXP45022	SXP45031	SXP45031	SXP45032
	Sample Date	09/01/93	09/15/93	11/30/93	09/01/93	09/15/93	11/30/93
Test	Parameter						
TAL METAL	Aluminum	10300			10500 !		
	Arsenic	4.67			4.76		
	Barium	17.4			19.8		
	Beryllium	0.407 J@			0.426 J@		
	Calcium	203 J			248 J		
	Chromium	36.0 !			44.4 !		
	Cobalt	4.98			5.10		
	Copper	9.25			13.7 !		
	Iron	10600			12000		
	Lead	47.0			310 !@		
	Magnesium	1640			1630		
	Manganese	107 !			194 !		
	Mercury	0.179			0.133		
	Nickel	8.84			9.53		
	Potassium	417 K			303 K		
	Selenium	0.224			0.235		
	Vanadium	17.3			16.1		
	Zinc	23.7 J			40.8 J		
TCL BNA	1DTCTL	1.40					
	C16AME						
	EMLIN						
	PADOE						
	ZMLIN	0.220					
TCL Pest	Aldrin		0.006 C			< 0.002	
	Dieldrin		0.005 U			0.001 JU	
	Endosulfan,A		0.015 U!			0.001 BJC	
	Endosulfan,B		0.007 U!			< 0.002	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S02	E3-P45-S02	E3-P45-S02	E3-P45-S03	E3-P45-S03	E3-P45-S03
	Field Sample ID	SXP45021	SXP45021	SXP45022	SXP45031	SXP45031	SXP45032
	Sample Date	09/01/93	09/15/93	11/30/93	09/01/93	09/15/93	11/30/93
Test	Parameter .						
TCL Pest	Endrin		0.010 U!			0.002 BJC	
	Endrin Aldehyde		0.011 C			< 0.002	
	Heptachlor Epoxide		< 0.002			< 0.002	
	P,P-DDD		0.010 U			0.007 U	
	P,P-DDE		0.010 C			0.016 C	
	P,P-DDT		0.014 C			0.020 C	
	alpha-BHC		0.004 C			< 0.002	
	beta-BHC		0.006 C!			< 0.002	
TOC	Total Organic Carbon	73900			55000		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S04	E3-P45-S04	E3-P45-S04	E3-P45-S05	E3-P45-S05	E3-P45-S05
	Field Sample ID	SXP45041	SXP45041	SXP45042	SXP45051	SXP45051	SXP45052
	Sample Date	09/01/93	09/15/93	11/30/93	09/01/93	09/15/93	11/30/93
Test	Parameter						
TAL METAL	Aluminum	9590			12000 !		
	Arsenic	5.75			6.17		
	Barium	18.2			24.4		
	Beryllium	0.390 J			0.462 J!@		
	Calcium	189 J			280 J		
	Chromium	15.7 !			20.4 !		
	Cobalt	5.06			4.95		
	Copper	9.30			10.0		
	Iron	10100			10600		
	Lead	32.0			30.0		
	Magnesium	1490			1500		
	Manganese	175 !			127 !		
	Mercury	0.088 J			0.111		
	Nickel	8.62			9.05		
	Potassium	365 K			351 K		
	Selenium	0.242			0.309		
	Vanadium	16.2			17.5		
	Zinc	20.5 J			25.8 J		
TCL BNA	1DTCTL						
	C16AME						
	EMLIN						
	PADOE						
	ZMLIN						
TCL Pest	Aldrin		0.001 BJU			0.000 BJC	
	Dieldrin		0.002 JU			0.001 JU	
	Endosulfan,A		0.000 BJC			0.000 BJC	
	Endosulfan,B		< 0.002			0.002 JU	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S04	E3-P45-S04	E3-P45-S04	E3-P45-S05	E3-P45-S05	E3-P45-S05
	Field Sample ID	SXP45041	SXP45041	SXP45042	SXP45051	SXP45051	SXP45052
	Sample Date	09/01/93	09/15/93	11/30/93	09/01/93	09/15/93	11/30/93
Test	Parameter .						
TCL Pest	Endrin		0.002 BJC			0.002 BU	
	Endrin Aldehyde		< 0.002			< 0.002	
	Heptachlor Epoxide		< 0.002			< 0.002	
	P,P-DDD		0.007 U			0.007 U	
	P,P-DDE		0.019 C			0.011 C	
	P,P-DDT		0.019 C			0.016 C	
	alpha-BHC		< 0.002			< 0.002	
	beta-BHC		< 0.002			< 0.002	
TOC	Total Organic Carbon	37800			57800		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S06	E3-P45-S06	E3-P45-S06			
	Field Sample ID	SXP45061	SXP45061	SXP45062			
	Sample Date	09/01/93	09/15/93	11/30/93			
Test	Parameter .						
TAL METAL	Aluminum	12000 !					
	Arsenic	6.34					
	Barium	24.5					
	Beryllium	0.493 J!@					
	Calcium	206 J					
	Chromium	20.7 !					
	Cobalt	4.94					
	Copper	9.54					
	Iron	12000					
	Lead	34.0					
	Magnesium	1570					
	Manganese	155 !					
	Mercury	0.111					
	Nickel	9.15					
	Potassium	340 K					
	Selenium	0.222					
	Vanadium	16.9					
	Zinc	22.5 J					
TCL BNA	1DTCTL						
	C16AME						
	EMLIN						
	PADOE	0.580					
	ZMLIN						
TCL Pest	Aldrin		0.001 BJC				
	Dieldrin		0.003 C				
	Endosulfan,A		0.002 KJC				
	Endosulfan,B		0.003 C				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 2-44
Chemical Summary Report For Surficial Soils
Site: P45
Units: UGG

	Site ID	E3-P45-S06	E3-P45-S06	E3-P45-S06			
	Field Sample ID	SXP45061	SXP45061	SXP45062			
	Sample Date	09/01/93	09/15/93	11/30/93			
Test	Parameter .						
TCL Pest	Endrin		0.008 KU				
	Endrin Aldehyde		< 0.002				
	Heptachlor Epoxide		0.001 JC				
	P,P-DDD		0.011 C				
	P,P-DDE		0.010 C				
	P,P-DDT		0.019 C				
	alpha-BHC		< 0.002				
	beta-BHC		< 0.002				
TOC	Total Organic Carbon	43500					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 2-45
Chemical Summary Report For Surface Waters
Site: P45
Units: UGL

	Site ID	E3-P45-D01					
	Field Sample ID	WXP45011					
	Sample Date	09/20/93					
Test	Parameter						
TAL METAL	Aluminum	447 J!					
	Arsenic	106 !@					
	Barium	22.7 !					
	Calcium	3660					
	Chromium	3.52 JK!					
	Cobalt	9.43 J!					
	Copper	4.35 J					
	Iron	7180 !#					
	Lead	6.20 #					
	Magnesium	1290					
	Manganese	1800 !					
	Nickel	10.2 !					
	Potassium	1670					
	Silver	2.97					
	Sodium	3170					
	Vanadium	5.47 J!					
	Zinc	45.8 !					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 2-46
Chemical Summary Report For Sediments
Site: P45
Units: UGG

	Site ID	E3-P45-D01					
	Field Sample ID	DXP45011					
	Sample Date	09/20/93					
Test	Parameter .						
TAL METAL	Aluminum	4910					
	Arsenic	19.0 !#					
	Barium	10.7					
	Beryllium	0.132 J					
	Calcium	247 J					
	Chromium	7.02					
	Cobalt	4.42 !					
	Copper	4.34					
	Iron	6940					
	Lead	4.00					
	Magnesium	1370					
	Manganese	81.9 !					
	Nickel	8.11 !					
	Potassium	380 K					
	Vanadium	9.05					
	Zinc	22.7 !					
TCL Pest	Endosulfan,A	0.000 JC					
TOC	Total Organic Carbon	28600					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column. U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

#=Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

3. WATERSHED 2 — HOP BROOK

3.1 WATERSHED DESCRIPTION AND ASSESSMENT

Proposed investigative activities for the sites identified at the Annex were determined through a review of previous activities and findings and are governed by the established SOW. The objectives of the activities are to determine whether contamination is present in the groundwater, surface water, sediment, or surface/subsurface soils at the assigned Phase II sites, and, in the cases where contamination is thought or known to exist, to confirm and better characterize its nature and extent.

To evaluate each site, and to develop a better understanding of the site's impact on the Annex environment, the Annex was divided into seven distinct watersheds. The general findings of the field effort are summarized for the individual watersheds. Detailed information about activities undertaken and sampling results for each site are then provided. Site results, conclusions, and recommendations are reviewed and discussed in conjunction with the results of the Phase I investigation conducted by OHM. The results are provided for investigations at each site. The methodology used in the screening of analytical results generated through this Phase II SI, and the screening values used to identify areas of possible concern, are fully explained in Section 7, Volume I of this report.

The sites discussed in Watershed 2 are listed in Table 3-1 and depicted in Figure 3-1.

3.1.1 Watershed Location and Description

Watershed 2 has been extensively studied as a possible municipal water supply for the Town of Maynard. A backup well (S115) was formerly in use to supplement White Pond as part of the town water supply by pumping from glacial outwash. Watershed 2 comprises most of the detached southern portion of the Annex south of Hudson Road and is drained by several tiny tributaries of Hop Brook, which are mostly unnamed but include Marlboro Brook. On the west, there is a poorly defined divide that runs approximately along the line of Bruen Road and separates this watershed from White Pond. Another poorly defined watershed divide stretches from the northwest end of Diagonal Road east to a hill of till (Hill

Table 3-1 WATERSHED 2 SITES		
Site Number	**Site Name**	**Status**
A10	Railroad Pit/UST Area	Site Investigation
A11	Leaching Field	Site Investigation
A12	PCB Spill; Remediation Area	Site Investigation
P28	Rocket Range/Railroad Classification Yard	Site Investigation
P36	Former Raytheon Building T104	Site Investigations
P37	Building T106 UST	Site Investigations
P38	Former Railroad Inspection Pit	Site Investigation
P39	Dump Area	Site Investigation
P48	Fuel Bladder Area	Site Investigation

Source: Ecology and Environment, Inc. 1994.

235 of Perlmutter 1962) and crosses a broad, flat wetland area. The eastern and southern boundaries of the watershed are along Hop Brook and lie outside the Annex boundaries. All the surface water within the watershed drains ultimately to Hop Brook.

Within Watershed 2 are nine sites studied by E & E: Sites A10, A11, A12, P28 (in part), P36, P37, P38, P39, and P48. The northern third of Site P28, the "rocket range," or railroad classification yard, extends up into Watershed 6; however, the entire site investigation will be discussed in this chapter.

There are a number of low hills or rises of till, and sometimes bedrock, within or near this watershed. Groundwater and surface water runs off these hills into the surrounding outwash and wetlands in all directions. The hills around the watershed are clockwise from the north end of the watershed, as follows: the hill east of the MFFA on Hudson Road; Hill 235, already mentioned; the hill at Site P36 (Hill 210 of Perlmutter); the hill south of Site P38 on the southern Annex boundary; and a small hill just southwest of the west gate, across White Pond Road. Water level measurements collected from monitoring wells throughout Watershed 2 on 13 September and 3 December 1993 were used to establish groundwater flow direction and hydraulic gradient. Average groundwater elevations presented in the "Physical Characteristics" description of each site are based on both sets of water level measurements. All measurements are presented in Table 3-2 as groundwater elevations.

The outwash is generally sandy and gravelly over much of the watershed. The upper part of the outwash (20 to 30 feet) is generally proglacial in the form of broad outwash plains

UC6S0348

WATERSHED 2 E&E SITES	
SITE NUMBER	SITE NAME
A10	RAILROAD PIT/UST AREA
A11	LEACHING FIELD
A12	PCB SPILL REMEDIATION AREA
P28	ROCKET RANGE
P36	FORMER RAYTHEON BUILDING T104
P37	BUILDING T106 UST
P38	FORMER RAILROAD INSPECTION PIT
P39	DUMP AREA
P48	FUEL BLADDER AREA

LEGEND:

- APPROXIMATE WATERSHED BOUNDARY
- BUILDING/STRUCTURE
- PAVED ROAD
- UNIMPROVED ROAD
- WATER BODY
- PERENNIAL STREAM
- INTERMITTENT STREAM
- RAILROAD
- FENCE
- INSTALLATION BOUNDARY
- 200 CONTOUR (25' INTERVAL)
- WETLAND
- **P26** **E&E SITE NUMBER IN BOLD**
- P12 OHM SITE NUMBER

ecology and environment

Figure 3-1 WATERSHED 2 - HOP BROOK

Table 3-2

WATERSHED 2 — HOP BROOK
WATER LEVEL MEASUREMENTS*

Site	Well	Water Levels**	
		09/13/93	12/03/93
A10	E3-A10-M01	186.25	186.49***
	OHM-A10-19	186.83	187.04
	OHM-A10-20	186.44	186.72
	DM1	186.61	186.79
	DM7	186.71	186.85
	DM11	186.77	184.90
A11	OHM-A11-21	180.00	180.20
	OHM-A11-22	179.07	179.54
	OHM-A11-23	184.58	184.70
P36	E3-P36-M01	195.49	195.73
	E3-P36-M02	185.09	186.59
	E3-P36-M03	177.25	177.57
P37	E3-P37-M01	182.36	181.98
	E3-P37-M02	176.93	176.99
	E3-P37-M03	175.15	173.24
	OHM-BW-1	173.19	172.78
P48	OHM-P48-41	187.20	187.80
	OHM-P48-42	187.28	187.81
	OHM-P48-43	187.40	187.90
	OHM-BW-2	187.24	187.67

*Includes data collected from OHM and Dames and Moore wells.
**All measurements are recorded in feet above mean sea level (AMSL).
***Measured on 01/12/94.

Source: Ecology and Environment, Inc. 1994.

laid down by melt-water streams issuing from the ice margin (Perlmutter 1962). The plains are fine-to-coarse-grained and well stratified in most places. The lower part, which is up to 55 feet thick, is composed chiefly of lake-bottom deposit beds of gray, very fine-grained sand and silt with some scattered lenses of coarse material. The thickness of the outwash depends on its location with respect to a buried valley of the preglacial Assabet River, which has been defined by a seismic survey (Perlmutter 1962). This valley runs from the east end of Boons Pond in Watershed 5, under the south end of White Pond, then turns northeast into Watershed 2 to run under Diagonal Road just north of its junction with Site P28 and out of Watershed 2, passing between Hill 235 and the hill west of the MFFA, and toward Willis Pond in Watershed 6. One backup well (labeled S115 in Perlmutter) used to supplement White Pond as a municipal water supply was installed by the Town of Maynard. It is situated east of Diagonal Road, halfway between Hills 210 and 235, and approximately 1,700 feet north of

Site P37. This well was installed next to a borehole (S111) that penetrated 58 feet of outwash and 10 feet of till and entered 15 feet into quartz-mica schist of the Marlboro Formation. Several other boreholes of varying depths showed similar geology (H7, S112, and S114) but S113, 900 feet east of S111, bottomed in granite or aplite. The water supply well yielded approximately 600 gpm, which would indicate a transmissivity in the aquifer of 4,545 feet^2 per day and a hydraulic conductivity of about 107 feet^2 per day. It should be noted that these are probably near maximum values for this aquifer.

3.1.2 Preliminary Watershed Assessment

In order to assess the overall impact of the Annex on the surrounding environment, a watershed approach has been adopted. This approach divides the facility into areas draining to particular streams of surface water bodies, both by surface runoff (which is minimal at the Annex) and by groundwater flow. Within each watershed, the individual sites are potential sources of contaminants and the surface water and sediments are potential receptors or sinks. The result of movement of water through the Annex and the discharge of groundwater to surface water is to move contaminants from the soil to groundwater and then to surface water and sediments.

Sediment layers are often organic-rich with high TOC that can adsorb contaminants occurring in groundwater before they reach surface water. Any persistent toxics present in the groundwater discharge can accumulate in sediments and in biota living in the streams and ponds. The result is that the impacts of all sites within a given watershed tend to be concentrated in the sediments within the surface water draining the watershed and in surface water itself.

The analysis of results of sediment and surface water sampling at the Annex along a given drainage may indicate where discharges from specific sites enter the surface water pathways. By sampling at the point where drainages leave the Annex or join a larger stream, an assessment can be made of the cumulative impacts of a particular watershed.

Sampling results are compared to background stream levels and also to preliminary screening values. Because no drainages enter the Annex areas in Watershed 2, no background sample specific to this watershed could be collected. Background levels in two streams that enter the northern part of the Annex were used for comparison purposes.

Surface water screening values include water quality criteria regarding both human health and aquatic life, while sediment screening values are ecologically-oriented. Surface water and sediment sampling results are also compared to site-specific groundwater and soil sampling results to attempt to identify potential sources of watershed contamination. Sampling results from previous investigations by Dames and Moore in 1984 and 1985, OHM in 1992 and 1993, and E & E in 1993 and 1994 have all been considered in the watershed assessments. Sampling results for field work conducted at Site P36 in April 1994 have not been included in this report. Results from the April 1994 sampling at Site P36 will be included in the RI report for Sites A12, P36, and P37. The number of samples used for analysis of particular contaminants varies depending on the varying analyte spectrum for each

sample used in this assessment. The surface water and sediment samples collected in Watershed 2 to date are listed in Table 3-3.

Table 3-3

SURFACE WATER/SEDIMENT SAMPLE LOCATIONS IN WATERSHED 2*

Site ID	Location
Marlboro Brook	
A11SD1/SW1	Marlboro Brook, northwest of Diagonal Road, upgradient of Site A11
E3-A11-D01	Marlboro Brook, southeast of Diagonal Road, downgradient of north part of Site A11
A11SD4/SW4	Marlboro Brook, downstream of E3-A11-D01, downgradient of north part of Site A11
A11SD2/SW2	Marlboro Brook, downstream of A11SD4/SW4, downgradient of leach field
A11SD3/SW3	Marlboro Brook, downstream of A11SD2/SD3, downgradient of leach field
SW/SED4 E3-A11-D02	Marlboro Brook, downstream of entry of eastern drainage from Site A11
E3-P37-D01	Marlboro Brook, upstream of small pond north of Site P37
E3-P37-D02	Marlboro Brook, downstream of small pond north of Site P37
E3-P37-D03	Marlboro Brook, at culvert under Moore Road, off Annex
Site P39 Wetlands	
P39SD1/SW1 P39SD2/SW2 E3-P39-D01..D05	Wetlands adjacent to Site P39
Site A10 Drainages	
E3-A10-D01	Tributary to Hop Brook, downgradient and southwest of Site A10
E3-A10-D02	Tributary to Hop Brook, downgradient and south of Site A10

*From upstream to downstream.

Source: Ecology and Environment, Inc. 1994.

Surface water and sediment sampling efforts in Watershed 2 have focused primarily on Marlboro Brook because it is one of the main drainages of this watershed, including the area of the former railway classification yard. Marlboro Brook receives drainage from Sites P28, P38, A11, P36, A12, and P37. Surface water and sampling efforts have also been conducted in the wetlands adjacent to Site P39 and in the drainages from Site A10. The wetlands at Site P39 are isolated and results from sampling there are likely to only indicate specific impacts of the debris at Site P39. Thus, surface water and sediment results from Site P39 are only discussed under the SI report for Site P39, and are not addressed in this watershed assessment. The drainages pathways from Site A10 only receive drainage from the former barracks area and diesel maintenance facility at this site. Results from surface water and sediment sampling in the Site A10 drainages are briefly addressed since they may indicated conditions of water flowing off the Annex that eventually enters Hop Brook.

3.1.2.1 Water Quality Conditions in Watershed 2

Water quality data collected at the time of E & E sampling indicated that Marlboro Brook is slightly acidic, with pH ranging from 5.60 to 6.90. The slightly acidic levels may have some impact on leaching metals from the surrounding soil. Turbidity levels in surface waters near the samples collected downstream of Site P37 were fairly high (from 180 mg/L to above 999 mg/L), which indicates a high level of suspended solids. Organic content of sediments in the upper portion of Marlboro Brook ranged from 2070 μg/g to 33,300 μg/g, while sediments further downstream below Site P37 ranged from 10,800 μg/g to 372,000 μg/g. The sediment sample with the highest organic content was located in a wetland area along Moore Road.

The southwestern drainage from Site A10 was strongly acidic (pH 3.84), while the turbidity level was relatively low (10.0 mg/L). No water quality parameters were recorded for the southeastern drainage from Site A10. The organic content of sediment samples in the Site A10 drainages was 268,000 μg/g and 564,000 μg/g in the southwestern and southeastern drainages respectively.

3.1.2.2 Sampling Results in Marlboro Brook

Analysis of surface and subsurface soil samples in the Rocket Range/Railroad Classification Yard (Site P28) and at the railroad inspection pit (Site P38) indicated several areas of surface soil contaminated with arsenic (from 33 μg/g to 4900 μg/g), several hot spots of antimony contamination (up to 120 μg/g), and one hot spot of petroleum hydrocarbons contamination (23,000 μg/g). In addition to impacts from sites further downstream, a key purpose of the assessment of Watershed 2 was to identify any contamination migration occurring via Marlboro Brook from the Rocket Range/Railroad Classification Yard.

Upstream of Site A11

Only one surface water and sediment sample has been taken to date at a point on Marlboro Brook upstream of Site A11. This sample (A1SD1), located northwest of Diagonal Road, is upstream of the leach field and debris at Site A11. No contaminants were identified in the surface water sample at levels above background and screening values. Several metals, including lead (9 μg/g) and zinc (13.1 μg/g) were found in the sediment sample above background levels, but were below screening levels. The DDT degradation product, DDD (0.023 μg/g), was found in this sample above the screening level of 0.002 μg/g (NOAA ERL), but not at a level that indicates any site-related contamination.

Southwest of Site A11

Two surface water and sediment samples (E3-A11-D01 and A11SD4) were taken along Marlboro Brook southwest of Site A11 at points that are downgradient of the northern portion of Site A11, but are probably upgradient of the leach field. Arsenic (440 μg/L) was significantly elevated in the E3-A11-D01 surface water sample above background and the screening level of 0.018 μg/L (MA/CWA WQC for consumption of water and fish). This

arsenic concentration was the only detection of arsenic at the Annex in surface water above the MA/CWA WQC level of 190 μg/L for the protection of aquatic life.

This surface water sample also contained cadmium (8.16 μg/L), copper (59.6 μg/L), iron (130,000 μg/L), lead (107 μg/L), and zinc (146 μg/L) all above background and screening levels for these compounds (MA/CWA WQC for protection of aquatic life). The copper and cadmium detections in this sample were the only concentrations of these compounds in surface water in Marlboro Brook above both background and screening levels. Although turbidity was not measured, this sample was collected at a time of low flow in Marlboro Brook, and the amount of suspended solids and sediment in the sample was probably high and would be a factor in the elevated concentrations of metals.

DDD (0.097 μg/L) and DDE (0.062 μg/L) were also found above screening levels in this surface water sample. This was the only point on Marlboro Brook where any pesticides were found in surface water.

In the second surface water sample taken on Marlboro Brook southwest of Site A11 (A11SW4), arsenic (31.8 μg/L), and lead (11.6 μg/L) were found at concentrations above background and screening levels. While the surface water sample at E3-A11-D01 may have been impacted by sediment or suspended solids, the findings at A11SW4 seem to confirm that arsenic and lead are concerns in surface water at this point in Marlboro Brook.

Arsenic and lead were found in one of the sediment samples on Marlboro Brook at a concentration slightly above background but below sediment screening levels. No metals were detected at concentrations above screening and background levels. DDT (0.005 μg/g), DDD (0.011 μg/g), and DDE (0.010 μg/g) were also found in one of the samples of concentrations above the screening level, but are unlikely to be site-related.

Downgradient of the Leach Field at Site A11

Four surface water and sediment samples (at A11SD/SW2, A11SD/SW3, SW/SED 4, E3-A11-D02) have been collected on Marlboro Brook downgradient of the leaching field at Site A11. The only contaminants identified in surface water in this area along Marlboro Brook were at E3-A11-D02 and SW4, which were both taken below the entry of a small drainage from the eastern side of Site A11. Arsenic (20.7 μg/L), iron (10,000 μg/L), and zinc (146 μg/L) in E3-A11-D02 were found at concentrations above background and screening values. Lead (3.43 μg/L) was also found at a concentration above the screening level in this sample, but was below the highest level found in background streams at the Annex (10.3 μg/L). Hexavalent chromium (Cr^{+6}) (20.0 μg/L) was found in the SW4 sample, above the screening level for Cr^{+6} of 11 μg/L (MA/CWA WQC for protection of aquatic life). This was the only sample in Marlboro Brook analyzed for Cr^{+6}. Other samples were only analyzed for total chromium, and none had levels of chromium in surface water or sediment above screening levels. Chromium (up to 27.1 μg/g) was found in several soil samples at Site A11 at concentrations above background, but well below the soil screening level of 200 μg/g (MCP GW-1/S-1). Chromium was not detected in groundwater at Site A11.

In sediment samples taken downstream of the leach field, arsenic (up to 32 μg/L) was elevated in three of four sediment samples taken in this area above background and the screening level of 6 μg/g (Ontario MOE LEL). Nickel (18.2 μg/g) was found in one sediment sample above background and the screening level of 16 μg/g (Ontario MOE LEL). Several pesticides were found at E3-A11-D02, downstream of the drainage from the eastern part of Site A11, including low levels of dieldrin (0.016 μg/g), DDD (0.057 μg/g), DDE (0.040 μg/g), and DDT (0.011 μg/g) in concentrations above sediment screening values. DDD (1.0 μg/g) was also found in SED4. Several PAHs were also found in SED4 but were below screening levels.

Arsenic, iron, and lead, which were found in surface water and sediment samples downstream of Site A11, were also found above screening levels in unfiltered samples from the three Site A11 monitoring wells but were not found in filtered samples. No pesticides were detected in groundwater at Site A11. No metals or pesticides were found in soil samples above screening levels.

Downstream of Sites A12, P36 and P37

Three surface water and sediment samples were collected from Marlboro Brook downstream of runoff from Sites A12, P36, and P37. Arsenic (up to 45.8 μg/L), iron (up to 14,000 μg/L) and lead (up to 23.2 μg/L) were found in two of the three surface water samples at concentrations above background and screening levels. The highest concentrations of arsenic, and iron were found at the sample taken at Moore Road (E3-P37-D03), and the highest level of lead was found upstream of these samples (E3-P37-D01). As noted above, turbidity levels found in water at these sample points were relatively high (from 180 mg/L to greater than 999 mg/L) indicating a high level of suspended solids or sediment in water that would affect metals concentrations. However, the turbidity level (180 mg/L) of the Moore Road sample, where the highest concentrations of most metals were found, was lower than that of the two samples taken further upstream.

In sediment samples from this part of Marlboro Brook, several metals and pesticides were also found above background and screening levels, particularly at the sediment sample taken at Moore Road. Arsenic (37.4 μg/g), cadmium (2.50 μg/g), iron (26,500 μg/g), lead (39.2 μg/g), manganese (1,680 μg/g), and nickel (20.7 μg/g) were found in this sediment sample above background and screening levels. The organic content (372,000 μg/g) of the Moore Road sediment sample was the highest of any sediment sample from Marlboro Brook, which indicates that the wetland area along Moore Road is likely to act as a receptor or sink for any potential contaminants flowing down Marlboro Brook. Pesticides were also found in the three sediment samples in this part of Marlboro Brook, with the highest concentrations found at the Moore Road sample. Pesticides found above background and screening levels included γ-chlordane (0.190 μg/g), endrin (0.024 μg/g), heptachlor epoxide (0.114 μg/g), and DDE (0.345 μg/g). Some of these pesticides were also detected in sediments at and below Site A11, but the levels at the Moore Road sample are higher than many upstream sediment samples. This pattern indicates two possibilities: (1) the source of the pesticides at the Moore Road sample may be related to a local source in the area off-Annex along Moore Road; or (2) pesticides used in the past at the Annex may be accumulating in the organic-rich

sediments in the wetland area along Moore Road. TPHC was also found only in the Moore Road sample (174 μg/g), probably indicating runoff from Moore Road.

Iron, lead, manganese, and nickel were found in unfiltered groundwater samples from the well that is upgradient of Site P36 (E3-P36-M01), indicating that these metals found in groundwater and in Marlboro Brook may be naturally occurring. These metals were not found above screening levels in filtered groundwater samples at Site P36 or Site P37. The only detection in the Site P36/A12/P37 area that may be related to surface water/sediment results in Marlboro Brook is TPHC (up to 1,800 μg/g) which was found in soil near the site of a removed UST at Site P37, and in a well downgradient of Site P37 (at 1,930 μg/L). However, TPHC was not elevated in the two sediment samples in Marlboro Brook closest to Site P37. The TPHC at the Moore Road sampling location is more likely the result of a runoff from Moore Road than discharge of groundwater from Site P37.

Tables 3-4 and 3-5 summarize the compounds found in surface water and sediment samples in Marlboro Brook above background and screening levels.

Table 3-4

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN MARLBORO BROOK SURFACE WATERS (μg/L)

Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Sample Location ID	Above Background and Screening Level	
						Locations Found	Frequency
Arsenic	3.15	0.018	MA/CWA WQC[1]	440	E3-A11-D01	Downstream of A11, downstream of P37	5/10
Cadmium	5	1.1	MA/CWA WQC[2]	8.16	E3-A11-D01	Downstream of A11	1/10
Chromium^{+6}	---	11	MA/CWA WQC[2]	20	SED4	Downstream of A11	1/1
Copper	10	12	MA/CWA WQC[2]	59.6	E3-A11-D01	Downstream of A11	1/10
Iron	4810	1,000	MA/CWA WQC[2]	130,000	E3-A11-D01	Downstream of A11, downstream of P37	5/10
Lead	10.3	3.2	MA/CWA WQC[2]	107	E3-A11-D01	Downstream of A11, downstream of P37	5/10
Zinc	13.3	110	MA/CWA WQC[2]	146	E3-A11-D02	Downstream of A11	2/10
DDD	--	0.00083	MA/CWA WQC[1]	0.097	E3-A11-D01	Downstream of A11	1/9
DDE	--	0.00059	MA/CWA WQC[1]	0.062	E3-A11-D01	Downstream of A11	1/9

[1]MA/CWA WQC = Massachusetts/Clean Water Act water quality criteria for protection of human health regarding consumption of water and fish.
[2]MA/CWA WQC = Massachusetts/Clean Water Act water quality criteria for protection of aquatic life.

Source: Ecology and Environment, Inc. 1994.

Table 3-5

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN MARLBORO BROOK SEDIMENTS (μg/g)

Compound	Max. Background	Screen Level	Source	Max. Concentration	Sample Location ID	Locations where found above background and screen level	Frequency above background and screen level
Arsenic	2.03	6	Ontario MOE LEL[1]	37.4	E3-P37-D03	Downstream of A11, downstream of P37	5/10
Cadmium	<0.500	0.6	Ontario MOE LEL	2.50	E3-P37-D03	Downstream of P37	1/10
Iron	7,590	20,000	Ontario MOE LEL	26,500	E3-P37-D03	Downstream of P37	1/9
Lead	4.48	31	Ontario MOE LEL	39.2	E3-P37-D03	Downstream of P37	1/10
Manganese	70.5	460	Ontario MOE LEL	1,680	E3-P37-D03	Downstream of P37	1/9
Nickel	5.92	16	Ontario MOE LEL	20.7	E3-P37-D03	Downstream of A11, downstream of P37	3/9
γ-Chlordane	---	0.0005	NOAA ERL[2] (for Chlordane)	0.190	E3-P37-D03	Downstream of A11	3/9
Dieldrin	--	.00002	NOAA ERL	0.016	E3-A11-D03	Downstream of A11	1/9
Endrin	--	.00002	NOAA ERL	0.024	E3-P37-D01	Downstream of P37	1/9
Heptachlor Epoxide	--	0.005	Ontario MOE LEL	0.114	E3-P37-D03	Downstream of P37	1/9
DDD	--	0.002	NOAA ERL	0.057	E3-A11-D02	Downstream of A11	2/9
DDE	--	0.002	NOAA ERL	0.345	E3-P37-D03	Downstream of A11	5/9
DDT	--	0.001	NOAA ERL	0.011	E3-A11-D02	Downstream of A11	2/9
TPHC	16.6	2	Ontario MOE LEL	174	E3-P37-D03	Downstream of P37	1/5

[1]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[2]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.

Source: Ecology and Environment, Inc. 1994.

3.1.2.3 Sampling Results from the Drainages From Site A10

Surface water samples from two locations in the southwestern drainage from Site A10 indicated lead (49.9 μg/L in E3-A10-P01 and 230 μg/L in E3-A10-D02), at concentrations above background and screening levels. This concentration exceeded the MA/CWA WQC for lead of 3.2 μg/L for the protection of aquatic life. Lead (370 μg/g) was found in one soil sample at Site A10 above the soil screening level of 300 μg/g (MCP GW-1/S-1). The surface water collected just south of the railroad tracks (E3-A10-D02) indicated the presence of several metals other than lead at concentrations above screening values. Arsenic was detected at a concentration (7.92 μg/L) well above the screening value of 0.018 μg/L developed under the Massachusetts CWA WQC for aquatic life. Copper (142 μg/L) was also found significantly above the WQC screening value of 12 μg/L. Zinc, iron, and several other metals were also found at levels above screening values. The elevated levels are most likely due to suspended solids present in the surface water at the time of sampling. Low levels of DDD (0.048 μg/g), DDE (0.027 μg/g), DDT (0.015 μg/g) and endosulfan sulfate (0.012 μg/g) were found in sample E3-A10-D01 above the screening levels.

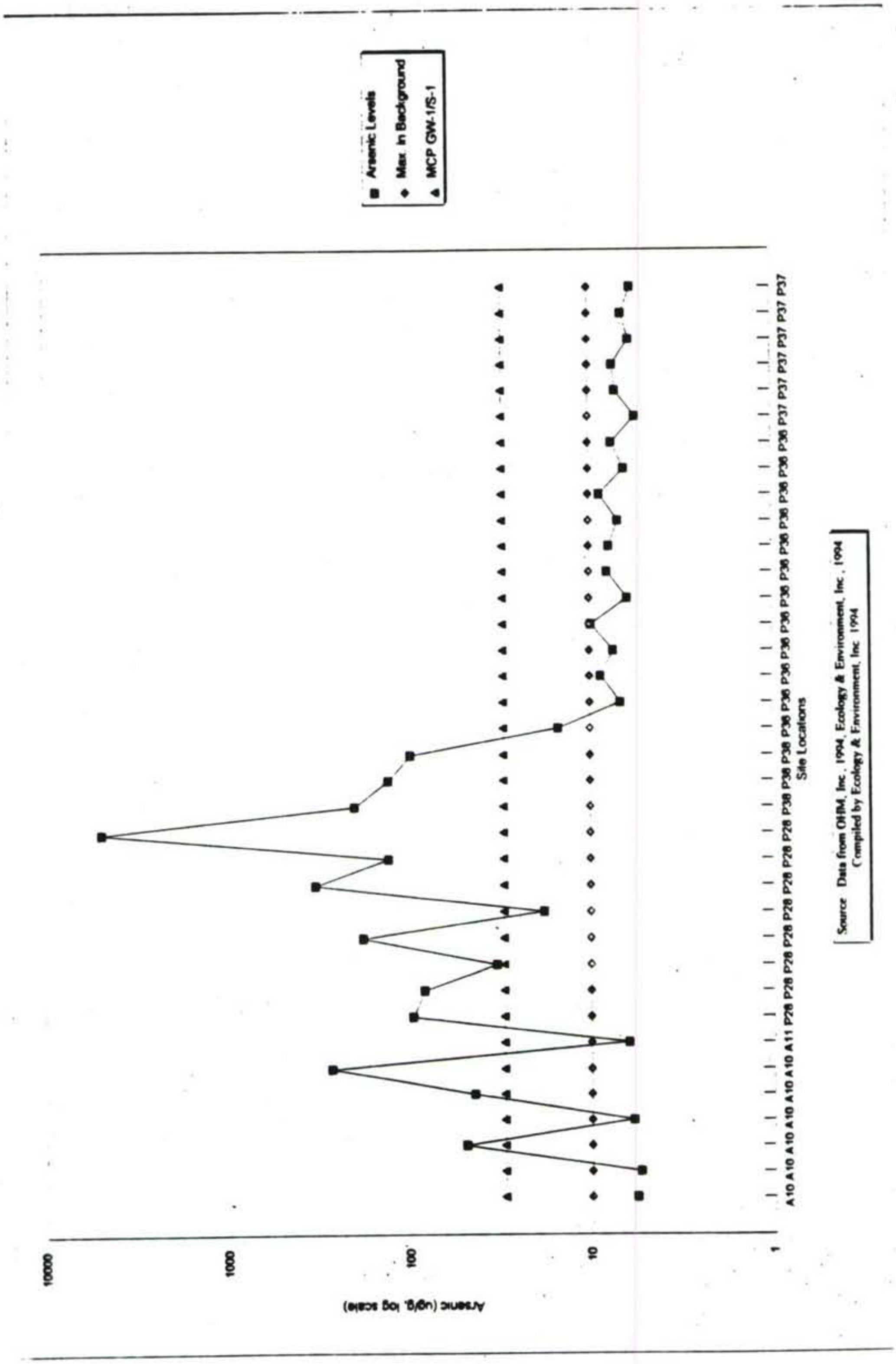
In the sediment sample taken from the southeastern drainage from Site A10, copper (77.1 μg/g) was found above background and the screening level of 16 μg/L (Ontario MOE LEL). TPHC (128 μg/g) were also found in this sample above background and screening levels.

With the exceptions of lead and arsenic, none of the compounds found in surface water or sediment samples in the Site A10 drainages above screening levels were found in groundwater or soil samples at Site A10 above screening levels.

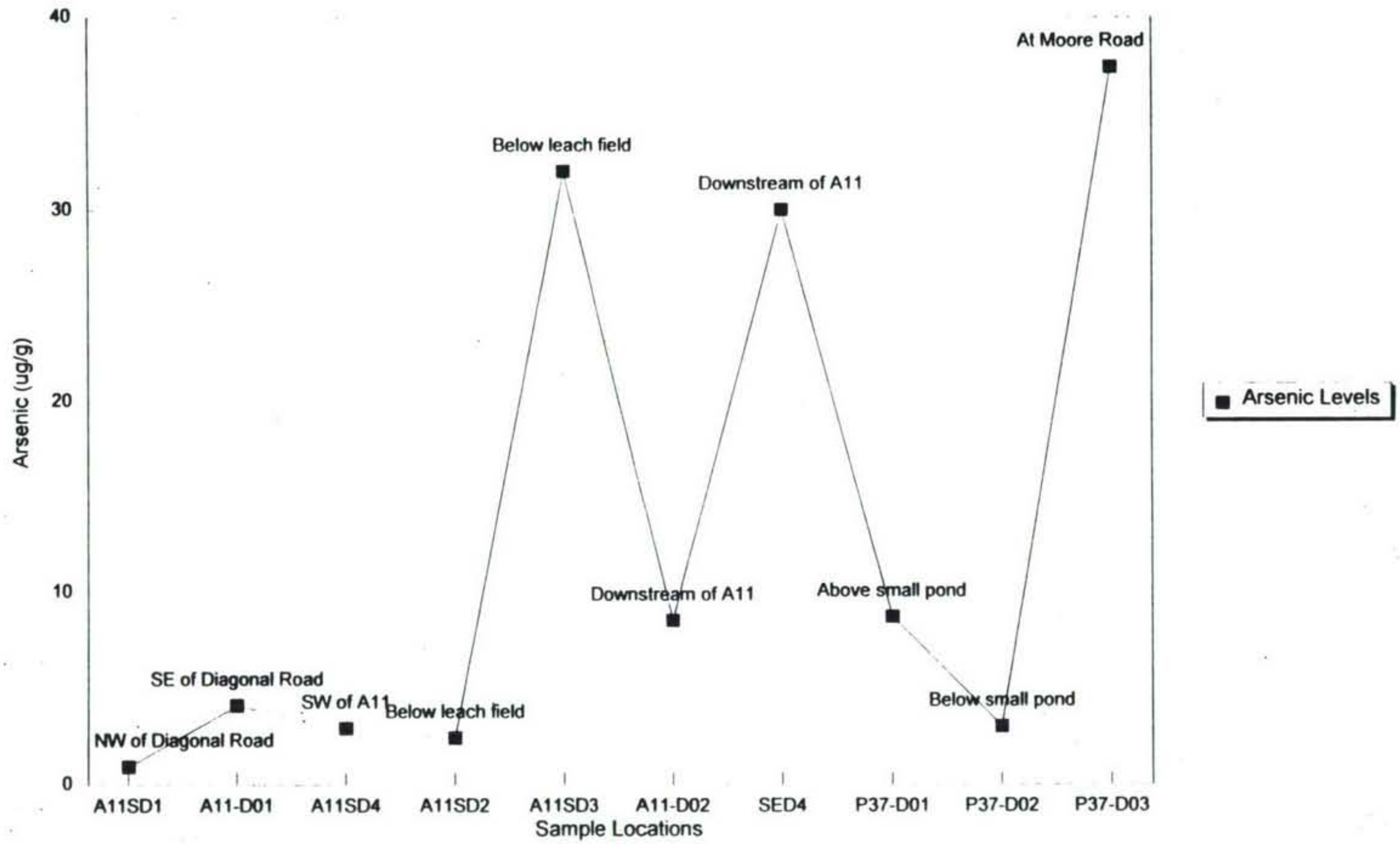
3.1.2.4 Summary of Watershed Assessment

Arsenic, iron, and lead were found in half of the surface water samples taken in Marlboro Brook. Iron and lead, however, were also found above screening levels in unfiltered samples from a well upgradient of Site P36, and the levels of these metals in Marlboro Brook are probably at least partially reflective of naturally occurring iron and lead in the area. The arsenic detections in over half of the sediment and surface water samples above background and screening levels, however, probably indicate site-related contamination. Given that arsenic was detected in several areas at the Rocket Range/Railroad Classification Yard at elevated levels (up to 4,900 μg/g), and consistently in surface water and sediments in Marlboro Brook, further investigation of Sites P28 and P38 should attempt to determine if the arsenic is due to former activities in the railroad yard area. In addition, this investigation should included sampling of other surface water drainages from the Rocket Range/Railroad Classification Yard to assess if arsenic contamination may also be present.

Graph 3-1 shows the arsenic levels found in soil samples at site in Watershed 2. The sites associated with railway operations (A10, P28, and P38) all have elevated concentrations of arsenic above the screening level, while concentrations of arsenic at other sites are below background levels, reinforcing the possibility that the likely source of arsenic in Marlboro



Graph 3-1 Arsenic Concentrations in Soils at Sites in Watershed 2



Source: Data from Ecology & Environment, Inc., 1994; OHM, Inc. 1994; Dames & Moore, Inc. 1986
Compiled by Ecology & Environment, 1994

Graph 3-2 Arsenic Concentrations in Sediments in Marlboro Brook

Brook is activity in the Rocket Range/Railroad Classification Yard and surrounding area. One possible activity in this area could be the use of arsenic-based herbicides for weed control in the years of railway operations (1942 to 1964) or the arsenic could come from coal ash or railroad ballasts. Graph 3-2 shows the arsenic levels in Marlboro Brook sediments.

The only other contaminants frequently found above background and screening levels in Marlboro Brook were pesticides. Pesticides were not found in groundwater or soils at the sites that drain to Marlboro Brook in concentrations above screening levels, and the likely source of these pesticides is pest management practices at the Annex and possibly in the area immediately off-site along Moore Road. While the levels of pesticides detected in sediments in Marlboro Brook at Moore Road may have a local off-site source, given the organic-rich nature of sediments in the wetland along Moore Road, it is also possible that pesticides may have accumulated at this point due to flow from the Annex. Further investigation of arsenic contamination in Watershed 2 should also include analysis for pesticides to confirm that the pesticides in Marlboro Brook are due to on-site or off-site pest management practices in the past, rather than a site-related source.

The only potentially site-related compound found in the drainages from Site A10 was lead which was found in the surface water samples at two locations in the southwestern drainage pathways at Site A10 and was also found in one of six soil samples at Site A10 above soil screening values.

3.1.3 QA/QC Program Analysis of Results for Watershed 2

This section provides a summary of the results of the QA/QC review performed using the protocol described in Volume I, Section 5.3.3.

Data for Watershed 2 were evaluated for usability by reviewing laboratory and field QC sample data for contamination possibly introduced into field samples by either sampling or analysis procedures. First, method blanks were reviewed for each analyte in the 262 lots associated with Watershed 2, followed by trip blanks and then rinsate blanks. Following consideration of laboratory and field QC blank samples data, laboratory flagging codes and USAEC data qualifiers were evaluated with laboratory control charts for each lot and sampled for quality assurance problems. Analytical results were then reviewed for precision through consideration of the RPD between each sample/duplicate pair and MS/MSD sample set.

Following is a discussion of samples for each study area affected by QA/QC evaluation. Samples with contamination also found in the blank were qualified either with a "B" usability code for "present in the blank" or a "K" usability code for a result-biased high. Samples considered to have quality assurance problems were qualified with either an "L" usability code for a result-biased low or "R" for rejected. Samples exhibiting either high or low recoveries were qualified with a "J" usability code for estimated or "R" for rejected. Appendix F provides a list of all QC summary data for method blanks, trip blanks, rinsate blanks, field duplicate samples, and MS/MSD samples.

3.1.3.1 Site A10 — Railroad Pit/UST Area

Blank contamination was found for 19 analytes in 28 samples. The analytes of concern were: α-BHC, acetone, α-endosulfan, aluminum, beryllium, methylene chloride, dieldrin, γ-chlordane, heptachlor, lindane, and zinc from method blank contamination due to carryover from the laboratory equipment, or analytical reagents and 1,3-dinitrobenzene, 3-nitrotoluene, aluminum, cadmium, carbon disulfide, iron, sodium, antimony, TPHC and zinc from rinsate blank samples. Sodium is attributable to the source water while aluminum, cadmium, iron, antimony, and zinc are probably due to particulates washed from the surface of the equipment. The presence of 1,3-dinitrobenzene and 3-nitrotoluene is attributable to carryover from laboratory equipment and TPHC may be due to residue on laboratory glassware. In any case these analytes within the sample data were attributed to the blanks. Only methylene chloride was found in the trip blank.

There were only three parameters in four samples biased high due to blank contamination. These were zinc in sample WX1001X1, beryllium in sample MXA10201, and sodium in sample MXA10D11.

Sample data for seven analytes in ten samples were qualified as biased low due to low surrogate recoveries. These included 1,3,5-trinitrobenzene for lot AANK, silver for lot AAVY, 2-amino-4,6-dinitrotoluene for lot AAUH, beryllium and copper from lot AAZR, antimony from lot ABAQ, and selenium from lot ABAR.

Although there were no circumstances for which data were qualified based on duplicate pairs results, lead and selenium were qualified as estimated due to low matrix spike recoveries.

3.1.3.2 Site A11 — Leaching Field

Analytes found in method blank samples associated with Site A11 which affected sample data included: α-BHC, α-endosulfan, aldrin, bis(2-ethylhexyl)phthalate, beryllium, methylene chloride, delta-BHC, dieldrin, endrin, endosulfan sulfate, γ-chlordane, heptachlor, heptachlor epoxide, lindane, DDD, and DDE. Of these contaminants, all can be attributed to lab associated contamination including beryllium, which is probably due to reagents. Rinsate samples contained 1,3-dinitrobenzene, 3-nitrotoluene, cadmium, sodium, lead, antimony, and zinc. All associated samples were appropriately qualified with a "B" to indicate that the concentration found in the sample was attributable to the blank. There were no analytes found in trip blanks associated with Site A11.

There were twelve samples for which analytes were qualified as biased high because of blank contamination. These were potassium in DX1001X1, manganese and sodium in MFA10012, zinc in sample MX1001X1, sodium in MXA10012, zinc in MXA10191, beryllium and zinc in MXA10201, manganese and sodium in sample MXA10D11, cadmium in sample SXA10021, sodium in samples SXA10031 and SXA10051, and zinc in sample WX1001X1.

After review of the control charts for lots AANK, AAVY, AAUH, AAZR, ABAQ, and ABAR, ten samples were qualified as biased low for one or more of the following: 1,3,5-trinitrobenzene, silver, 2-amino-4,6-dinitrotoluene, beryllium, copper, antimony, and selenium.

The final QA/QC issue associated with Site A11 involved low recoveries for selenium and 1,3,5-trinitrobenzene in the MS/MSD samples. As a result, these analytes were qualified as estimated in the excavation samples for Site A11.

3.1.3.3 Site A12 — PCB Spill; Remediation Area

Only five analytes were found in the method blanks associated with samples from Site A12. For the two surface soil samples SXA12021 and SXA12031, endrin, endosulfan sulfate, and heptachlor epoxide were qualified as found in the blank. Dieldrin was also found, but only in the method blank for SXA12021. Alpha-endosulfan was also found, but only in the method blank for sample SXA12031.

There were no other QA/QC issues for Site A12.

3.1.3.4 Site P28 — Rocket Range/Railroad Classification Yard

Twenty-five samples were affected by four analytes found in the method blanks associated with Site P28. These analytes were acetone and methylene chloride and were attributable to common laboratory contamination, zinc which may have been due to the standard matrix water, and LINOLA which is a TIC and is not quantitatively reportable. Analytes found in the rinsate blanks associated with Site P28 include bis(2-ethylhexyl) phthalate, a ubiquitous field contaminant, sodium, cadmium, lead, antimony, and zinc which are all attributable to either the source water or particulates entrained in the rinsate water. Samples affected by rinsate blank contamination included BX280301, SX2805X1, SX2804X1, BX2801X1, and SX2803X1. The only parameter which was found in trip blank samples associated with Site P28 was methylene chloride.

Thirteen samples from Site P28 were qualified as biased high for zinc, potassium, antimony, sodium, or cadmium because the concentrations which were found in the samples were greater than five times the concentration found in the rinsate blanks.

In eight samples, cobalt, lead, and DDT were qualified as estimated due to low MS/MSD recoveries. The samples affected were soil samples SX2801X1 through SX2808X1.

No other QA/QC issues were noteworthy for Site P28.

3.1.3.5 Site P36 — Former Raytheon Building T104

Blank contamination was observed for 14 analytes in 38 samples. Analytes found in the method blanks were: bis(2-ethylhexyl)phthalate and methylene chloride from common laboratory contamination, aluminum, lead, and zinc from either analysis reagents or

processing of the samples, and potassium and sodium from the standard water matrix. Analytes found in the rinsate blanks included: aluminum, bis(2-ethylhexyl)phthalate, cadmium, iron, heptachlor, lindane, sodium, lead, antimony, TPHC, and zinc all attributable to the same sources as discussed previously. In all cases, sample data were qualified as found in the blank.

There were seventeen samples for which sample data were biased high due to blank contamination. Analytes of concern included: bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, cadmium, potassium, sodium, lead, antimony, and zinc.

A review of control charts submitted by the laboratory revealed that for lot AART, five surrogates had low recoveries. As a result, this BNA lot was qualified as biased low for all analytes.

On review of duplicate pair precision data associated with Site P36, only α–chlordane and DDE in the duplicate sample pair (SX3601X1/SD3601X1) were qualified as estimated due to exceedances of RPD precision criteria.

MS/MSD precision criteria were exceeded for barium and magnesium in MS/MSD sample MXP36011 and for nickel, antimony, and selenium in MS/MSD sample BX360101. As a result, ten samples from Site P36 were qualified as estimated for one or more of these analytes.

There were no other QA/QC issues associated with Site P36.

3.1.3.6 Site P37 — Building T106 UST

Site P37 had 34 samples affected by one or more of the 19 analytes found in either the method or rinsate blanks associated with Site P37. Specifically, this included acetone, α-endosulfan, aluminum, aldrin, bis(2-ethylhexyl)phthalate, methylene chloride, diethyl phthalate, endosulfan sulfate, potassium, lindane, sodium, lead, and zinc from method blanks, and aluminum, bis(2-ethylhexyl)phthalate, cadmium, methylene chloride, carbon disulfide, iron, heptachlor, lindane, manganese, sodium, lead, antimony, and zinc from rinsate blanks. In all cases, sample data were qualified as found in the blank.

There were also 21 samples for which data were qualified as biased high because of blank contamination. Analytes which were affected in one or more samples included beryllium, cadmium, endrin, endosulfan sulfate, potassium, lindane, sodium, TPHC, and zinc.

A review of laboratory control charts revealed four lots for which data were biased low due to low surrogate recoveries. In total, 68 analytes from one or more of nine samples (DXP37011, DXP37021, DXP37031, MDP37011, MRP37021, MXP37011, MXP37021, SX3705X1, and SX3706X1) were affected.

Only TOC exceeded RPD precision criteria for duplicate pairs. As a result, only samples BX370302 and BD370302 were qualified as estimated.

There were 13 samples for which one or more of 9 analytes were qualified as estimated due to low MS/MSD recoveries. Analytes of concern included: α-endosulfan, arsenic, barium, calcium, dieldrin, endrin, manganese, mercury, and DDT.

No other QA/QC issues at Site P37 were observed.

3.1.3.7 Site P38 — Former Railroad Inspection Pit

Eleven analytes were found in method blanks, and three analytes were found in the rinsate blanks associated with Site P38. In total, ten samples were affected by blank contamination and were qualified as estimated in the blank. Analytes of concern included: α–endosulfan, β-endosulfan, cadmium, methylene chloride, dieldrin, endrin, endrin aldehyde, γ-chlordane, heptachlor epoxide, lindane, LINOLA, sodium, lead, DDD, and DDE. In all cases, the presence of these analytes is attributable to laboratory equipment carryover, the source water or the standard matrix. LINOLA is a TIC and is not quantitatively reportable. Methylene chloride was the only analyte found in trip blanks for samples collected at Site P37.

In some samples, potassium, DDD, DDE, antimony, and zinc were qualified as biased high because the concentrations of these analytes found in the samples were greater than the blank comparison level. In total, seven samples were affected.

Although no sample data were qualified as estimated due to duplicate pair precision results, seven samples were qualified as estimated for lead, antimony, selenium due to low recoveries. Additionally, dieldrin in three samples (SX3801X1, SX3802X1, and SX3803X1) was qualified as rejected due to extremely low MS/MSD recoveries.

3.1.3.8 Site P39 — Dump Area

Method blank samples contained 2,4,6-tribromophenyl, acetone, and methylene chloride at concentrations sufficient to qualify seven samples. Additionally, carbon disulfide was found in the sediment rinsate blank and was qualified as found in the blank for DD3901X1 and DX3902X1.

Potassium and carbon disulfide were also found in the rinsate blank at concentrations high enough to only qualify data for samples DX3902X1, DX3903X1, DX3905X1, and DX3906X1 as biased high.

The only other QA/QC issue for Site P39 involves the qualification of data based on laboratory control charts. Lot AANP was qualified as biased low because of low surrogate recoveries, while lots AANU and AANV were qualified as biased low due to improper preparation of the high surrogate spikes. In total, only seven samples were affected: DD3901X1, and DX3901X1 through DX3906X1.

3.1.3.9 Site P48 — Fuel Bladder Area

Methylene chloride was the only analyte found in the method blanks associated with Site P48. Only samples BX480101, BX480102, BX480201, BX480202, BX480301, and BX480302 were qualified for methylene chloride as found in the (method) blank. Additionally, 1,1,1-trichloroethene was found in the trip blank associated with Site P48, but this only affected the rinsate sample collected at Site P48, BR4801X1.

Because there were no other QA/QC issues associated with Site P48, all other data for this site should be completely usable.

3.2 SITE DESCRIPTIONS AND ASSESSMENTS

3.2.1 Site A10 — Railroad Pit/UST Area

Site A10 was first identified when, during a field inspection (date unknown), USAEC located a concrete pit under a section of railroad track. Figure 3–2 is a map of Site A10.

3.2.1.1 Site Location

Site A10 is located southeast of Bruen Road, approximately 200 feet from the southwestern boundary of the Annex. The site can be reached via the paved Firehouse Road. Approximately 800 feet southeast of Firehouse Road's intersection with Bruen Road, an unpaved road diverges from Firehouse Road southeast into a cleared area, which constitutes the site. This road continues southeast before splitting; one branch leads east and another continues south. There are several mounds of soil overgrown with grasses in this clearing.

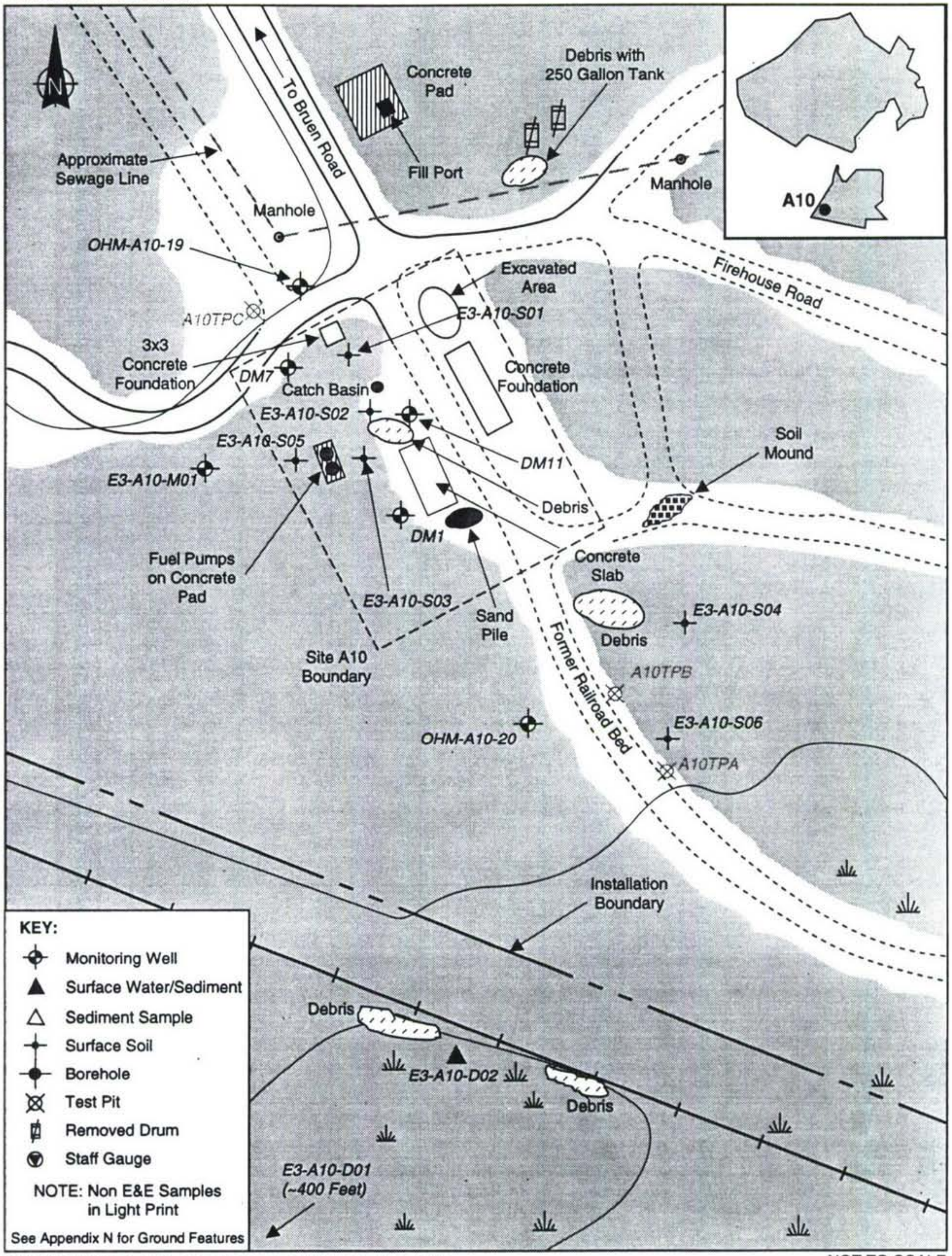
The most prominent feature of the site is a 20 foot by 100 foot concrete foundation on the eastern side of the unpaved road and about 200 feet south of Firehouse Road. Across the unpaved road is another slab of concrete foundation. To the north of the second concrete foundation lies a pile of debris and to the south, a mound of sand. What appears to be a catch basin lies north of the second concrete foundation and scattered rusted metal cans lie in the vicinity. To the west, within the forest, there are two fuel pumps on a concrete pad. South of Firehouse Road within the forest, there is a 3 $foot^2$ cement foundation with a metal pipe leading directly into the ground.

3.2.1.2 Physical Characteristics

Site A10 is located in an area of glacial outwash sand and gravel. The surface elevation across the site is approximately 199 feet AMSL. The average groundwater elevation is 187 feet AMSL.

Three monitoring wells (DM1, DM7, and DM11) were installed by Dames and Moore in 1984. Two additional wells (OHM–A10–19 and OHM–A10–20) were installed by OHM in 1992. A sixth well (E3–A10–M01) was constructed in 1993 by E & E. The borings of all six monitoring wells encountered only outwash material consisting of poorly sorted sand with trace silt and some gravel. Boring depths ranged from 19 to 22 feet BGS. Bedrock was not encountered during subsurface exploration; however, a seismic survey of the area (Perlmutter 1962) interpreted bedrock at 60 to 70 feet BGS. A soil sample collected from the 9- to 11-foot interval of the boring at E3–A11–M01 was submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as non-plastic, poorly graded sand with gravel. Additional grain size and Atterberg limits analyses were performed on surface soil sample E3–A10–S02 and on sediment samples E3–A10–D01 and E3–A10–D02. The surface soil was identified as non-plastic silty sand. Sediment sample E3-A10-D01 was identified as poorly graded sand with silt and gravel with a very high plasticity. Sediment sample E3–A10–D02 was identified as silty sand with an extremely high plasticity.

11: SUDBURY\UC6_A10.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-2 MAP OF SITE A10 RAILROAD PIT/UST AREA

Appendix D has complete geotechnical laboratory reports. Bedrock is probably amphibolitic schist of the Marlboro Formation (Hansen 1956).

OHM performed slug tests on the three Dames and Moore wells and the two OHM wells in 1992 and calculated an average aquifer transmissivity of 2,000 feet^2 per day. Based on seismic survey information, an aquifer thickness of 55 feet was used to make this calculation. A separate slug test conducted on well E3-A10-M01 by E & E in 1993 yielded a very low aquifer transmissivity of 39.92 feet^2 per day. Aquifer thickness was presumed to be equal to the length of the water column in the well at the time of the slug test. The transmissivity was calculated as follows:

$$T = Kb$$
$$T = (6.653)\ (6.000)$$
$$T = 39.92 \text{ feet}^2 \text{ per day}$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer thickness (feet)

Difficulty with data collection and a conservative estimate of aquifer thickness invalidate this low transmissivity calculation. Complete slug test data and interpretation can be found in Appendix G. The moderate transmissivity of 2,000 feet^2 per day is a more accurate assessment of aquifer characteristics at the site.

Surface water at Site A10 flows south to the abandoned Boston and Main Railroad, then the flow follows the ditch along the railroad bed east to a wetland, which is ultimately drained by Hop Brook, a tributary of the Sudbury River. Water levels and hydrogeologic data indicate that groundwater flow is south under the railroad bed to a nearby wetland. This wetland is also drained by Hop Brook.

3.2.1.3 Ecological Characterization

There are several vegetation types within the boundary of this site. A long meadow, vegetated with grasses, forbs, shrubs, and young growth trees, is on the northeastern side of the old paved road and extends to the southeastern corner of the site. North and southwest of the clearing there are two small remnant stands of pine barren, pith pine and oak trees, ranging from 20 to 40 feet in height (Aneptek 1991). Beyond the pine barren, the site is vegetated with a dense growth of red pines ranging from 40 to 60 feet in height (LFS 1983). Due to the dense canopy closure within this forest type, the understory is limited to regenerating overstory. The ground is covered with a thick mat of pine needles.

Three relatively small forested wetlands approximately 600 feet south and southwest of Site A10 receive surface water runoff from the site (E & E 1994b). These wetlands are seasonally saturated and vegetated with deciduous trees (USDOI 1977).

This area consists primarily of upland forested habitat and meadows. The association of pitch pine and oak trees found on this site is referred to as a pine barren community. This community is threatened by development pressures and fire exclusion practices and is considered a unique habitat type in Massachusetts (NHESP, undated). Pines and oaks are very important to wildlife as upland game birds, songbirds, and small mammals rely on pine seeds and acorns for much of their diet (Martin *et al.* 1951). Pine trees also serve as cover for deer and rabbits, especially in the winter. Meadows such as the one on the site support a variety of wildlife species including reptiles, small mammals, ground-nesting birds, browsers, burrowers, and raptors. Forested wetlands similar to the small ones south of the site combine an abundance of nutrients, diverse woody species, and available water. Consequently, such areas attract an array of aquatic species and upland species, as well as species specifically adapted to wetlands.

Two Massachusetts watch-list species, the eastern bluebird (*Sialia sialis*) and the purple martin (*Progne subis*), were reportedly observed approximately 1,000 feet northeast of the site by residents of the Capehart Family Housing Area (CFHA) (Aneptek 1991). The eastern bluebird's habitat includes forest edges, grasslands, and shrub areas. Site A10 combines some of these features; hence, the eastern bluebird is likely to frequent the site. The purple martin prefers farmlands or parks near water. Although it is possible that the purple martin will visit the site, areas near wetlands to the south or north of the site are more suited to its habitat requirements. No unique habitats have been identified in the general vicinity of the site (NHESP 1992).

3.2.1.4 Site History

A USAEC (date unknown) field inspection identified a concrete pit under an area where there was a railroad track in the southern portion of the Annex. The pit contains associated pipes and boxes likely to have been be connected with USTs. The pit is at the site of what was a locomotive shelter, and was used for locomotive and equipment maintenance. The locomotive shelter was built in 1942 as part of the original Annex construction. At that time, its designation was Building T6. This structure was demolished by burning in 1963 and the railway tracks leading to the location were removed in 1967. The remaining pit was reportedly used by local residents of the CFHA and the general public for automobile oil changes, engine oil was drained and reportedly discarded in the pit (Interview 1990c).

As part of the original construction of the Maynard Ammunition Depot in 1942, a gasoline pump house (designated as Building T5) was erected near the terminus of the railroad tracks adjacent to the barracks area. Two additional fuel pumps (identified in a 1944 map as Structure No. 16) were located west of the locomotive shelter. Two USTs were connected to the fuel pumps and one 5,000-gallon UST was connected to the gasoline pump house (Building T5).

Building T5 was demolished in March 1962, but the 5,000–gallon UST was apparently left intact. No information on removal of this UST could be obtained. However, a small, burned concrete foundation with a metal pipe is present at the approximate location of this demolished building. An interview with a Natick Laboratory employee (Interview

1985a) noted that the two tanks west of the concrete pit were a fuel and a lube tank used previously for locomotive maintenance. These tanks were emptied and filled with water when no longer needed and are still apparent at the site.

A storehouse was located east of the railroad tracks. The concrete pad on the east side of the road through the site area today is probably the foundation of the storehouse. This structure was probably Building T-7, which was demolished in 1962 and whose described dimensions match the remaining 20 by 100 foot foundation.

3.2.1.5 Results of Previous Investigations

In 1984, Dames and Moore installed three monitoring wells (DM1, DM7, and DM11) around the site. They sampled and analyzed groundwater from these wells for VOCs, BNAs, and metals and reported the organic compounds detected in the groundwater samples to be attributable to laboratory handling; the only metal detected was manganese.

In 1992, OHM performed a Phase I SI, which included a site reconnaissance, a geophysical study, test pit excavations with subsurface soil sampling, well installation, and groundwater sampling, to attempt to identify contamination possibly associated with the USTs in the area. No evidence was found of any USTs still in place. Geophysical anomalies were detected and identified as scrap metal and wood debris.

Buried trash, including a crushed 55-gallon drum, a metal pipe, a metal hinge, pieces of concrete, vinyl siding, and plastic sheeting was found in test pit A10TPA. In test pit A10TPB, a galvanized steel post, pieces of concrete, tree limbs, and unburnt pieces of coal were uncovered. In test pit A10TPC, concrete foundations, boulders, reinforced concrete, steel pipes and conduits, and a water line shutoff valve, marked "Pioneer Gilbertville, Massachusetts" were found. OHM took three soil samples from each of the excavated pits and analyzed them for TCL volatiles and semivolatile compounds, TCL pesticide/PCBs, TAL metals, and explosives. The only compounds found above background levels were pesticides and PCBs in test pit samples A10TPA and A10TPB. In A10TPC 0.077 μg/g DDT and 0.344 μg/g PCB 1260 were found in the same sample. Low levels of PAH above background levels were also found.

Subsurface soil samples were also taken during monitoring well installation. Other metals found above background were calcium (868 μg/g), magnesium (2,820 μg/g), and zinc (99.5 μg/g).

Analytical data from groundwater sampling (OHM 1993) indicate that in October 1992, wells DM-11 and OHM-A10-20 contained di-n-butyl phthalate (5.1 μg/L and 5.8 μg/L, respectively) and that well OHM-A10-20 also contained a trace of carbon disulfide (2.8 μg/L) in June 1992. One explosive was also reported, but unconfirmed, for well DM-7 in June 1992. A number of metals were noted in all groundwater samples, but none were suggestive of contaminants originating at Site A10.

3.2.1.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL volatiles, TAL metals, explosives, and TPHC. Sediment samples, one surface soil sample, and a subsurface soil sample were also analyzed for TOC, grain size and Atterberg limits. In addition, the surface water and sediment samples collected from location E3-A10-D01 were analyzed for TCL BNAs, TCL pesticides and PCBs, phosphates, herbicides, and organophosphorus pesticides. These sampling parameters were added to those originally proposed in the technical plans to more fully characterize the surface water quality of a stream downgradient of the site and of a large portion of the Annex. A summary of Phase II Sampling Activities at Site A10 is provided as Table 3-6.

Table 3-6

PHASE II SAMPLING EFFORT AT SITE A10 — RAILROAD PIT/UST AREA

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	7	08/24/93 09/01/93 12/03/93 01/12/93	Samples were collected to investigate groundwater quality and the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	1	08/12/93	Geotechnical sample was collected from the screened interval to characterize the nature of subsurface soils and their impact upon contaminant migration in the groundwater pathway.
	1	08/12/93	Sample was collected from the screened interval and sent for TOC analysis to provide data on the nature of the area's subsurface soils.
Surface Soils	6	09/14/93	Samples were collected to assess the nature of surface soil contamination on site.
	1	09/15/93	Sample was collected for TOC analysis.
	1	09/15/93	A geotechnical sample was collected to characterize the nature of the soil.
Surface Water	2	08/10/93 09/23/93 12/02/93	Surface water and sediment samples were collected to investigate surface water quality and the potential for contaminant migration through the surface water pathway.
Sediments	2	08/10/93 09/23/93 12/02/93	See Surface Water Sampling Rationale.
	2	08/10/93 08/10/93	Samples were collected for TOC analysis.
	2	08/10/93 08/10/93	Geotechnical samples were collected to determine the nature of soils.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

To characterize groundwater quality at Site A10, E & E installed, developed, and sampled one shallow overburden monitoring well, E3-A10-M01. The well was completed

downgradient of the site and within the area where groundwater was suspected to flow to the southwestern corner of the southern portion of the Annex. The well is screened across the water table at an interval of 8.5 to 18.5 feet BGS. The monitoring well was sampled during the two rounds of groundwater with both filtered and unfiltered samples taken at each round of sampling in August and December 1993. As a result of the QA/QC protocols approved in the QAPjP, E & E recollected the samples from well E3-A10-M01. Samples were analyzed for TCL volatiles in January 1994.

To further investigate groundwater quality and the potential for contaminant migration in the groundwater pathway, E & E sampled five previously installed monitoring wells. All five wells (DM1, DM7, DM11, OHM–A10–19, and OHM–A10–20) were sampled during the first groundwater sampling event in late August and early September 1993.

The total of seven samples collected during the August and December 1993 sampling events were used to characterize the groundwater pathway.

Subsurface Soil Sampling

During monitoring well construction, samples were collected from the screened interval and sent for TOC analysis. In addition, geotechnical samples were collected for grain size and Atterberg limits analyses. These samples provide data on the nature of the subsurface soils in the area and the potential for contaminant migration in the groundwater pathway.

Surface Soils Sampling

Six surface soil samples were collected in September 1993 to investigate surface soil contamination across the former railroad pit and UST area. The samples were collected from areas that had soil discoloration, stressed vegetation, or were lying in surface drainage channels. A surface soil sample collected at location E3-A10-S02 was analyzed for TOC. A sample collected at the same location was also sent for grain size and Atterberg limits analyses.

Surface Water and Sediment Sampling

A total of two surface water and two sediment samples were collected from two locations downgradient of the site. One surface water and one sediment sample were collected from location E3–A10–D01. The sample location lies approximately 500 feet southwest of the abandoned B&M Railroad tracks, which make up the southern border of the southern portion of the Annex. The analytical parameters for E3-A10-D01 were increased to allow for a full spectrum analysis to completely characterize the water quality of the stream. The stream is suspected of receiving surface runoff and possibly groundwater discharge from the Annex and can provide data to assess the impact of past site activities on off-site locations.

Due to the relatively dry summer, only a sediment sample was collected from the second sampling location (E3–A10–D02) in August 1993. To complete the original work plan

sampling requirements, a surface water sample was collected during the relatively wet December sampling period. The samples were collected from a wetland located adjacent to the abandoned B&M Railroad tracks and southeast of the site.

Geotechnical samples were collected from the surface water and sediment sampling location and sent for grain size and Atterberg limits analyses. An additional sample was collected from the stream sediments and sent for TOC analysis. The samples provide data to characterize the stream sediments and the potential for contaminant migration in the surface water pathway.

3.2.1.7 Nature and Extent of Contamination

Analysis of unfiltered groundwater samples collected in August and December 1993 indicate the presence of aluminum, arsenic, iron, lead, and manganese above preliminary screening values. These levels most probably result from suspended solids in the groundwater samples. This theory is supported after comparing contaminant levels in unfiltered and filtered groundwater samples. The two highest concentrations of aluminum (15,000 μg/L and 16,000 μg/L) were detected in the unfiltered samples from wells E3-A10-M01 and OHM-A10-20, respectively. However, the concentration detected in the corresponding filtered sample from well E3-A10-M01 fell to 19.4 μg/L (estimated), a level significantly lower than the 300 μg/L screening level established under Massachusetts SMCLs for drinking water. A summary of detections above preliminary screening levels is provided in Table 3-7. Additionally, the analytical results for Site A10 are presented in Tables 3-8 through 3-12, following Section 3.2.1.8, Conclusions and Recommendations for Site A10.

The same pattern occurs in the unfiltered results for iron and manganese. The highest detected concentration found for iron (18,000 μg/L), was in the unfiltered sample for well E3-A10-M01. The concentration in the filtered sample from E3-A10-M01 (19.0 μg/L, estimated), was significantly lower than the 300 μg/L screening level established under the Massachusetts SMCLs for drinking water. The highest concentration of manganese (264 μg/L) found in the unfiltered groundwater samples at Site A10 was from well E3-A10-M01. In the filtered sample from the same well, the concentration of manganese (68.1 μg/L) found was slightly above the SMCL screening value of 50 μg/L. Lead also fell from an unfiltered concentration of 44.2 μg/L in December 1993 to less than 5.00 μg/L in the corresponding filtered sample.

Arsenic (120 μg/L) was found in the groundwater at well E3-A10-M01 in the unfiltered sample. Although this is above the SMCL screening level of 50 μg/L, the concentration dropped to less than 2.0 μg/L in the filtered sample. This once again indicates that the higher levels of metals are most likely due to suspended solids present in the groundwater. Previous filtered groundwater sampling conducted by OHM in 1992 did not indicate any existing wells with arsenic concentrations above the Massachusetts SMCL screening level of 50 μg/L.

Table 3-7

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE A10

Medium (Units)	Compound	Maximum Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1] Aluminum(F)[2]	-- --	50	MA SMCL[3]	16,000	OHM-A10-20	6/6 *
	Arsenic(U) Arsenic(F)	--	50	MA MCL[4]	120 <2.00	E3-A10-M01 E3-A10-M01	1/6 0/2
	Iron(U) Iron(F)	-- --	300	MA SMCL	18,000	E3-A10-M01	6/6 *
	Lead(U) Lead(F)	-- --	15	SDWA MCL	44.2(est.) <5.00	E3-A10-M01 E3-A10-M01	1/6 0/1
	Manganese(U) Manganese(F)	-- --	50	MA SMCL	988 68.1	E3-A10-M01 E3-A10-M01	5/6 1/1
SOIL (μg/g)	Arsenic	10	30	MCP GW-1/S-1[5]	270	E3-A10-S06	3/6
	Lead	150	300	MCP GW-1/S-1	360	E3-A10-S02	1/7
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[6]	7.92	E3-A10-D01	2/2
	Copper	<10	12	MA/CWA WQC[7]	143	E3-A10-D02	1/2
	Iron	4.810	1000	MA/CWA WQC[7]	13,000	E3-A10-D02	1/2
	Lead	10.3	3.2	MA/CWA WQC[7]	230	E3-A10-D02	2/2
	Zinc	13.3	110	MA/CWA WQC[7]	168	E3-A10-D02	1/2
SED (μg/g)	Beryllium	0.18	0.4	MCP GW-1/S-1	1.62(est.)	E3-A10-D02	1/2
	Copper	6.33	16	Ontario MOE LEL[8]	77.1	E3-A10-D02	1/2
	DDD	--	0.002	NOAA ERL[9]	0.048	E3-A10-D01	1/1
	DDE	--	0.002	NOAA ERL	0.027	E3-A10-D01	1/1
	DDT	--	0.001	NOAA ERL	0.015	E3-A10-D01	1/1
	TPHC	16.6	2	Ontario MOE LEL	128	E3-A10-D02	1/2

[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MA MCL = Massachusetts Maximum Contaminant Level.
[5]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[6]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for protection of human health re: consumption of water and fish.
[7]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for protection of aquatic life.
[8]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[9]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.
*Filtered sample not available.

Source: Ecology and Environment, Inc. 1994.

Analysis of surface soil samples collected at Site A10 indicates the presence of arsenic and lead at concentrations above preliminary screening levels. Arsenic was found in samples from three sample locations at concentrations above the Massachusetts' Contingency Plan (MCP) screening level of 30 μg/g (GW-1/S-1). Samples from E3-A10-S03 and E3-A10-S05 had arsenic at concentrations of 49.0 μg/g and 44.0 μg/g, respectively, just above the screening level value at 30 μg/g. Samples from E3-A10-S06 had arsenic (270 μg/g), significantly above the MCP screening level.

The highest concentration of lead found in the surface soil sample from location E3-A10-S02 was 360 μg/g. This concentration is slightly above the MCP screening level of 300 μg/g for lead contamination in Level 1 groundwater and Level 1 soils (GW-1/S-1). However, this lead concentration does not exceed the less restrictive MCP screening value of 600 μg/g for Level 3 groundwater and Level 3 soils (GW-3/S-3). Sample location E3-A10-S02 lies adjacent to metallic surface debris which may be a possible source. No other sample had lead concentrations above the highest recorded background soil level of 150 μg/g.

Analysis of surface water and sediment samples taken from two drainages from the general area around Site A10 indicated the presence of several metals, particularly lead, in the surface water above background and screening levels, in addition to some pesticides. Due to the pattern of drainage for Site A10 itself, at the time of the August 1993 sampling there were no identifiable surface drainages from the site on the north side of the railway bed that also serves as the Annex building. Thus, surface water and sediment samples were taken free to drainages downgradient of the railroad tracks and off the Annex property. There is a significant amount of household dumping and debris, including at least one car battery were noted just upgradient of the E3-A10-D01. Given the distance of these samples from Site A10 (1100 feet to E3-A10-D01 and 500 feet to E3-A10-D02), the fact that metals were not found in a mobile dissolved state in groundwater samples at the site, and the intervening railroad bed and debris dumping off the Annex that could contribute to metals contamination at these drainages, it is probable that the source of the elevated metals, including lead, is due to the presence of the railroad bed and this debris, and is not thought to be related to Site A10 itself. The sampling results of each surface water/sediment location are discussed below.

Analysis of the surface water sample from E3–A10–D01 indicated arsenic and lead above preliminary screening levels. Arsenic (1.49 μg/L) was above the screening value of 0.14 μg/L identified in the MA CWA AWQC for protection of aquatic life. However, it was well below the maximum background level of 3.15 μg/L for arsenic. Lead was found in the surface water sample from E3–A10–D01 at a concentration of 49.9 μg/L, also above the AWQC screening value of 3.2 μg/L.

Analysis of the corresponding sediment sample collected at E3–A10–D01 indicated the presence of cadmium and several pesticides (α–chlordane, DDT, and its degradation products DDD and DDE), at concentrations elevated above lowest effect level screening values. α–chlordane (0.003 μg/L) was above the NOAA ERL screening level of 0.0005 μg/L where an estimated 10 percent of benthic organisms would show signs of being affected at the specified ERL concentration level. DDT (0.015 μg/L) is above the NOAA ERL screening level of 0.001 μg/L. DDE (0.027 μg/L) and DDD (0.048 μg/L) were also above both of their ERL screening levels of 0.002 μg/L.

All four of these concentrations were compared to a second set of screening levels developed by NYSDEC. These SQC allow determination of criteria based upon a site-specific equilibrium partitioning approach. All four of the pesticide concentrations at sediment location E3–A10–D01 were above their ERL screening levels, yet all four concentrations were significantly below the second range of screening levels. The α–chlordane concentration (0.003 μg/L) was well below the site specific SQC screening level of 0.268 μg/L. DDT (0.015 μg/L) was also significantly below the SQC screening level of 0.22 μg/L. The degradation products DDD (0.048 μg/L) and DDE (0.027 μg/L) were also significantly below both of their SQC screening levels of 0.268 μg/L.

Cadmium (1.15 μg/L) was also slightly above the most restrictive screening level of 0.6 μg/L developed by the Ontario MOE LEL.

Analysis of the surface water sample collected in December 1993 at location E3-A10-D02 indicated the presence of several metals at concentrations above screening levels. Lead was the most significant contaminant found at a concentration (230 μg/L) well above the screening level 3.2 μg/L (Massachusetts WA WQC for the protection of aquatic life). Arsenic was also detected at a concentration (7.92 μg/L) above the screening value of 0.018 μg/L (Massachusetts QC for aquatic life). Copper was also found (143 μg/L) significantly above the WQC screening value of 12 μg/L and iron and zinc were also found at levels above screening values.

Analysis of the sediment sample collected at location E3–A10–D02 indicated the presence of beryllium and copper concentrations above screening levels for these compounds (GW–1/S–1). Beryllium was detected at a concentration of 1.15 μg/L (estimated), above the lowest GW–1/S–1 screening level of 0.4 μg/L. Copper (77.1 μg/L) was found approximately 5 times the screening level of 16 μg/L developed by the Ontario MOE for the LEL. However, the concentration of copper is below the mid-level screening level or ERM of 390 μg/L developed by NOAA. TPHCs were also found in the sediment from location

E3-A10-D02 at a concentration of 128 μg/L, above the screening value of 2 μg/L (Ontario MOE LEL).

This elevated concentration is probably from residual hydrocarbons near the old abandoned railroad track bed, approximately 40 feet north of sampling location E3-A10-D02.

3.2.1.8 Conclusions and Recommendations

The original concern at Site A10 was residual contamination due to USTs and a concrete pit reportedly used for the storage of fuel and waste oils which accumulated during routine railroad car maintenance operations at the site. The metals aluminum, arsenic, lead, and manganese were found above screening levels in the unfiltered groundwater. After groundwater filtering, however, only manganese was detected above the Massachusetts screening level for drinking water, indicating that the metals contamination is most likely due to the presence of suspended solids in the groundwater. The manganese is probably naturally elevated, as it is elsewhere in the Annex.

Pesticides were found in only one sampling location (E3-A10-D02), at levels which do not point to site-related sources and are consistent with pest management practices at the Annex.

Surface water and sediment samples collected from two areas downgradient of the site indicate the presence of several metals at levels which are likely due to runoff from the railroad bed and household debris dumping in the areas upgradient of the two sample points. Given that elevated levels of dissolved metals were not identified in groundwater for the site, and that debris and the railroad bed off the Annex are much closer to the surface water and sediment sample points where some elevated metals were found, these detections are not thought to be related to Site A10.

The majority of contaminants identified during the investigations at Site A10 were at levels below screening values. No contaminant plumes were identified and sampling results do not indicate any widespread or localized contaminant sources attributable to Site A10, with the possible exception of the facility-wide arsenic problems discussed in the "Conclusions and Recommendations" in Volume I, Chapter 8.

The elevated arsenic concentrations in the surface soils may indicate an unidentified contaminant source exists at the site. Further investigations have been recommended for Sites P28 and P38 based upon similar arsenic contamination in each site. If these additional investigations identify definite sources of arsenic contamination, possibly due to past railroad activities, then remedial activities may be recommended. If this scenario develops at the Rocket Range/Railroad Classification Yard further activities may also be needed at Site A10.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-8
Chemical Summary Report For Groundwater
Site: A10
Units: UGL

	Site ID	DM1	DM11	DM7	E3-A10-M01	E3-A10-M01	E3-A10-M01
	Field Sample ID	MXA10D11	MXA10111	MXA10071	MF1001X1	MFA10012	MX1001X1
	Sample Date	09/01/93	09/01/93	09/01/93	08/24/93	12/03/93	08/24/93
Test	Parameter						
EXPLOSIVES	2,4-DNT	< 1.00	< 1.00	< 1.00			< 1.00
	2-Nitrotoluene	1.09 U	< 1.00	< 1.00			< 1.00
TAL METAL	Aluminum	1140 @	1240 @	4090 @	19.4 BJ	29.9 B	15000 @
	Antimony	< 5.00	< 5.00	< 5.00	3.04 BJ	6.56 B@	< 5.00
	Arsenic	< 2.00	2.58	11.9	< 2.00	< 2.00	27.4
	Barium	10.8	9.92 J	37.2	15.9	16.7	66.4
	Beryllium	0.159 BJ	< 5.00	< 5.00	< 5.00	0.931 J	0.536 J
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00	1.74 J	< 5.00
	Calcium	4500	3090	2600	3380	4860	4850
	Chromium	4.95 J	3.00 J	5.44 J	< 10.0	< 10.0	20.8
	Cobalt	< 10.0	< 10.0	3.08 J	4.84 J	< 10.0	10.2
	Copper	< 10.0	< 10.0	5.45 J	< 10.0	< 10.0	16.0
	Iron	785 @	1780 K@	5090 K@	19.0 BJ	25.9 B	18000 @
	Lead	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	10.7
	Magnesium	512	642	1430	422 J	526	2710
	Manganese	14.3 K	27.9	70.1 @	68.1 @	14.8 K	264 @
	Nickel	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	22.7
	Potassium	1240	978 J	1950	1380	930 J	2870
	Selenium	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	1.68 J
	Sodium	2400 K	2130	8450	4490	5300 K	5190
	Vanadium	< 10.0	< 10.0	7.29 J	< 10.0	< 10.0	17.6
	Zinc	55.2 B	26.1 B	22.3 B	11.4 BJ	10.5 BJ	68.1 K
TCL VOA	Carbon disulfide	< 5.00	< 5.00	5.30 B			< 5.00
TPHC	Total Petroleum Hydrocarbons	< 2000	< 2000	< 2000			918 J

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-8
Chemical Summary Report For Groundwater
Site: A10
Units: UGL

Test	Site ID	E3-A10-M01	E3-A10-M01	OHM-A10-19	OHM-A10-20		
	Field Sample ID	MXA10012	MXA10013	MXA10191	MXA10201		
	Sample Date	12/03/93	01/12/94	09/01/93	09/01/93		
Test	Parameter .						
EXPLOSIVES	2,4-DNT	< 1.00		< 1.00	< 1.00		
	2-Nitrotoluene	< 1.00		< 1.00	< 1.00		
TAL METAL	Aluminum	70000 @		4150 @	16000 @		
	Antimony	4.86 J		< 5.00	< 5.00		
	Arsenic	120 @		4.34	31.3		
	Barium	192		27.2	44.3		
	Beryllium	2.87 J		0.264 BJ	0.650 KJ		
	Cadmium	< 5.00		< 5.00	< 5.00		
	Calcium	8530		6610	3050		
	Chromium	67.8		7.04 J	15.8		
	Cobalt	45.2		< 10.0	6.80 J		
	Copper	73.2		2.99 J	9.13 J		
	Iron	77000 @		4680 @	11000 @		
	Lead	44.2 J@		< 5.00	8.32		
	Magnesium	9910		1620	2660		
	Manganese	988 @		86.6 @	246 @		
	Nickel	63.4		13.1	14.1		
	Potassium	7110		1620	1960		
	Selenium	< 2.00 J		< 2.00	< 2.00		
	Sodium	6730 K		4490	3200		
	Vanadium	79.2		6.90 J	13.4		
	Zinc	167		49.8 B	46.9 B		
TCL VOA	Carbon disulfide		3.30 J	< 5.00	< 5.00		
TPHC	Total Petroleum Hydrocarbons	106 BJ		< 2000	< 2000		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-9
Chemical Summary Report For Subsurface Soils
Site: A10
Units: UGG

	Site ID	E3-A10-M01					
	Field Sample ID	BX1001X1					
	Sample Date	08/12/93					
Test	Parameter Depth	14.0 ft.					
TOC	Total Organic Carbon	2520					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94 File Type: CSO Site Type: AREA	Table: 3-10 Chemical Summary Report For Surficial Soils Site: A10 Units: UGG	Page 1 of 1 Part 1 of 2

	Site ID	E3-A10-S01	E3-A10-S01	E3-A10-S02	E3-A10-S03	E3-A10-S04	E3-A10-S05
	Field Sample ID	SDA10011	SXA10011	SXA10021	SXA10031	SXA10041	SXA10051
	Sample Date	09/14/93	09/14/93	09/15/93	09/14/93	09/14/93	09/14/93
Test	Parameter .						
EXPLOSIVES	1,3-Dinitrobenzene	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
	2-Amino-4,6-dinitrotoluene	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
	4-Amino-2,6-dinitrotoluene	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
TAL METAL	Aluminum	6680	6290	6740	6610	7490	8220
	Antimony	< 0.500	< 0.500	0.367 BJL	0.435 BJ	0.242 BJ	0.483 BJ
	Arsenic	5.46	5.65	5.37	49.0 !@	5.86	44.0 !@
	Barium	19.8	18.8	39.1 !	16.0	22.3	29.1 !
	Beryllium	0.241 J	0.234 J	0.326 JL	0.224 J	0.297 J	0.350 J
	Cadmium	0.379 BJ	0.513 BJ!	1.38 K!	0.278 BJ	0.301 BJ	0.298 BJ
	Calcium	328 J	401 J	1740 !	413 J	1620 !	518 J
	Chromium	9.85	9.87	15.5 !	13.1	22.3 !	12.3
	Cobalt	5.38	5.28	7.43 !	4.43	6.96 !	7.45 !
	Copper	9.42	1.15	31.8 L!	15.5 !	14.0 !	13.0 !
	Iron	7750	7780	11100	9290	9160	10800
	Lead	18.0	25.0	360 !@	140	25.0	18.0
	Magnesium	1560	1620	227400 !	1630	2340 !	1960
	Manganese	142 !	141 !	158 !	80.1	175 !	178 !
	Nickel	9.78	9.36	12.1 !	9.42	10.4	13.6 !
	Potassium	637 !	651 !	725 !	709 !	681 !	1030 !
	Sodium	71.8 BJ	75.8 BJ	50.7 BJ	240 K	301	186 KJ
	Thallium	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	0.261 J
	Vanadium	13.1	13.3	18.8	20.1	18.5	15.9
	Zinc	81.4 !	96.8 !	310 J!	50.1 !	75.5 !	41.7
TCL VOA	4BFB						
TOC	Total Organic Carbon			44500			
TPHC	Total Petroleum Hydrocarbons	39.8	41.9	352	116	57.2	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-10
Chemical Summary Report For Surficial Soils
Site: A10
Units: UGG

	Site ID	E3-A10-S06					
	Field Sample ID	SXA10061					
	Sample Date	09/14/93					
Test	Parameter .						
EXPLOSIVES	1,3-Dinitrobenzene	< 1.00					
	2-Amino-4,6-dinitrotoluene	< 1.00					
	4-Amino-2,6-dinitrotoluene	< 1.00					
TAL METAL	Aluminum	6450					
	Antimony	2.28 !					
	Arsenic	270 !@					
	Barium	25.8 !					
	Beryllium	0.165 J					
	Cadmium	0.186 BJ					
	Calcium	474 J					
	Chromium	11.2					
	Cobalt	4.63					
	Copper	9.62					
	Iron	9540					
	Lead	14.0					
	Magnesium	2280					
	Manganese	84.4					
	Nickel	7.53					
	Potassium	1620 !					
	Sodium	156 KJ					
	Thallium	0.238 J					
	Vanadium	17.5					
	Zinc	28.5					
TCL VOA	4BFB	0.039					
TOC	Total Organic Carbon						
TPHC	Total Petroleum Hydrocarbons	< 20.0					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 3-11
Chemical Summary Report For Surface Waters
Site: A10
Units: UGL

Test	Parameter	E3-A10-D01	E3-A10-D01	E3-A10-D02			
	Field Sample ID	WX1001X1	WXA10011	WXA10022			
	Sample Date	08/10/93	09/23/93	12/02/93			
EXPLOSIVES	Tetryl, total	< 1.00		< 1.00			
TAL METAL	Aluminum	153		4230 !			
	Arsenic	1.49 J@		7.92 !@			
	Barium	25.2 !		116 !			
	Beryllium	0.855 J		0.841 J			
	Calcium	10000 !		10600 !			
	Chromium	< 10.0		7.75 J!			
	Cobalt	< 10.0		15.4 !			
	Copper	< 10.0		143 !#			
	Iron	588		13000 !#			
	Lead	49.9 !#		230 !#			
	Magnesium	2300 !		2680 !			
	Manganese	208 !		732 !			
	Nickel	< 10.0		19.1 !			
	Potassium	968 J		1680			
	Sodium	16000 !		2580			
	Vanadium	< 10.0		20.8 !			
	Zinc	36.3 K!		168 !#			
TCL VOA	Acetone	< 10.0		11.0			
	Carbon disulfide	< 5.00		3.90 J			
TPHC	Total Petroleum Hydrocarbons	< 2000		200 J			
WQP	Phosphorus, Total		17.0				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 3-12
Chemical Summary Report For Sediments
Site: A10
Units: UGG

	Site ID	E3-A10-D01	E3-A10-D01	E3-A10-D02			
	Field Sample ID	DX1001X1	DXA10011	DX1002X1			
	Sample Date	08/10/93	09/23/93	08/10/93			
Test	Parameter .						
TAL METAL	Aluminum	4430		4330			
	Arsenic	6.00 !		4.13 !			
	Barium	23.5 J		112 !			
	Beryllium	< 0.500		1.62 J!@			
	Calcium	2530 J!		4580 !			
	Chromium	8.36 JK		< 2.00 K			
	Cobalt	< 1.00		8.67 !			
	Copper	7.82 !		77.1 !#			
	Iron	5480		14000 !			
	Lead	16.1 !		19.5 !			
	Magnesium	1340 J		< 500			
	Manganese	58.2		78.3 !			
	Nickel	7.21 !		16.0 !			
	Potassium	413 KJ		< 200			
	Selenium	< 0.200		1.70 !			
	Vanadium	9.27 J		6.26 J			
	Zinc	22.4 !		40.2 !			
TCL Pest	Endosulfan Sulfate		0.012 CK!				
	P,P-DDD		0.048 C#				
	P,P-DDE		0.027 C#				
	P,P-DDT		0.015 C#				
TOC	Total Organic Carbon	268000		564000			
TPHC	Total Petroleum Hydrocarbons	< 20.0		128 !#			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column. U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
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!= Exceeds Background.

3.2.2 Site A11 — Leaching Field

Site A11 was identified by USAEC personnel during a field investigation. Because there was a lack of information about the size and location of the leaching field, it was included as a site to be investigated at the Annex. Figure 3-3 provides a map for Site A11.

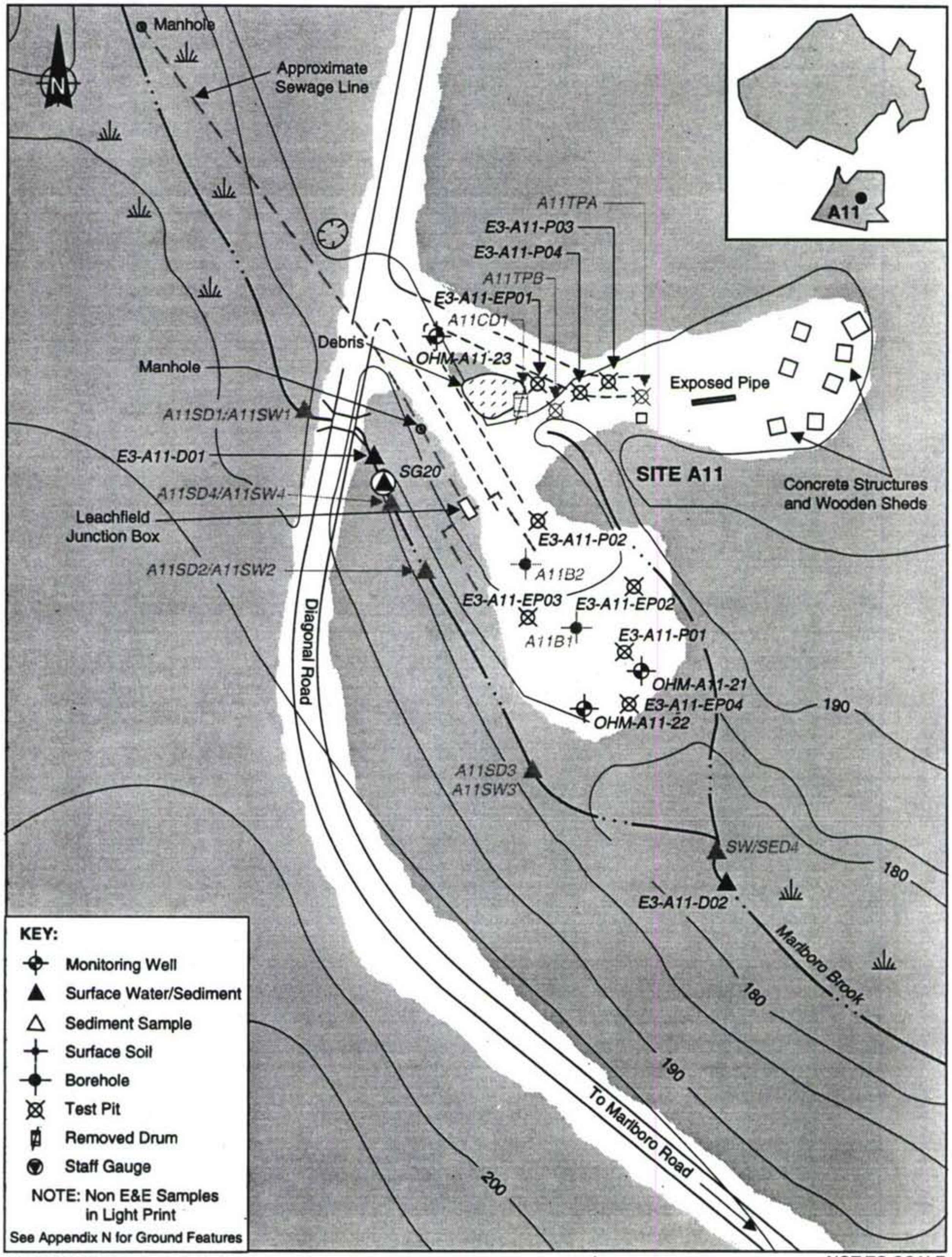
3.2.2.1 Site Location

Site A11 is located in the southern part of the Annex, east of the intersection of Marlboro Brook and Diagonal Road. The site is bounded by Marlboro Brook and Diagonal Road on its western edge and by a forest on all other sides. Access is through a gate at the entrance of the site, on an unpaved road that diverges southeast from Diagonal Road. Approximately 50 feet past the gate, the access road splits, one road leads to a clearing in the eastern part of the site, the other to a clearing in the southern part of the site. Both cleared areas are covered with sand and slope gently to the southeast. In addition, the eastern cleared area appears to have been excavated as a material pit. In the same cleared area, there are several scattered concrete structures that have a concrete foundation with a north, inset brass plate, apparently used for scientific experiments. Near the entrance to this cleared area, there is also an exposed, 6-foot long clay pipe, and a 6-by-6-foot wooden shed. The junction box for the leach field is located just north of the southern clearing. Between the two cleared areas is a large pile of metal debris, which includes the remnants of a demolished shed. No drums were found during an October 1993 site walkover.

3.2.2.2 Physical Characteristics

Site A11 is on an area of glacial outwash sand and gravel immediately east of Marlboro Brook. Surface elevations in the area range from 187 to 194 feet AMSL. Average groundwater elevations range from 180 to 185 feet AMSL.

Three monitoring wells (OHM-A11-21, OHM-A11-22, and OHM-A11-23) were installed by OHM Corporation in 1992. Borings at OHM-A11-21 and OHM-A11-22, which are on the southeastern edge of the leach field, encountered a poorly sorted sand with a trace of gravel to depths of 13 and 14 feet, respectively. It is difficult to determine whether this material is fill or original to the area; however, the strata were clearly disturbed during construction of the leach field. A thin, organic layer of leached material was observed in both borings between 6 and 9 feet BGS. A layer of dense, gray, silty sand, indicative of a low energy depositional environment, extended through the remaining depth at each location. Both borings achieved a total depth of 20 feet BGS. A boring at OHM-A11-23 installed upgradient (north) of the leach field showed outwash material consisting of a coarser sand and gravel mixture extending nearly the entire 20-foot boring length. A trace of gray, silty fine sand was observed at the bottom of the boring. Additional subsurface soil explorations in the leach field include two 8-foot borings installed by OHM Corporation in 1992 and two test pits excavated by E & E in 1993, each to a depth of 6 feet. These explorations encountered poorly sorted sand with trace gravel similar to the material observed during well installation at OHM-A11-21 and OHM-A11-22.



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-3 MAP OF SITE A11 LEACHING FIELD

Four test pits were excavated in the eastern cleared area at Site A11. Tests pits A11TPA and A11TPB, excavated by OHM Corporation in 1992, reached total depths of 4.5 and 6 feet, respectively. Test pits E3-A11-P03 and E3-A11-P04 were each excavated to a total depth of 6 feet by E & E in 1993. Poorly sorted sand with trace gravel similar to material encountered in the leach field extended through the entire depth of each pit.

Two sediment samples, E3-A11-D01 and E3-A11-D02, were collected by E & E in the streams draining the site and submitted for grain size and Atterberg limits analyses. Sediment sample E3-A11-D01 was identified as a non-plastic, poorly graded sand with gravel. Sediment sample E3-A11-D02 was identified as a non-plastic, well-graded sand with silt. Please refer to Appendix D for complete geotechnical laboratory reports.

Bedrock was not encountered during any subsurface explorations. However, interpretation of a seismic survey indicates that depth to bedrock may be between 30 and 60 feet BGS (Perlmutter 1962).

Slug tests were performed by OHM in 1992 on the three monitoring wells discussed earlier. An average transmissivity of 100 feet^2 per day was calculated for the three wells, based on an average aquifer thickness of 30 feet. Aquifer thickness was based on results of the aforementioned seismic refraction survey (Barnes 1956). The low transmissivity is comparable to other transmissivities calculated in outwash material across the facility.

Surface water at Site A11 flows predominantly southeast, eventually draining to Marlboro Brook. Water levels and hydrogeologic data indicate that groundwater flow is also southeast to Marlboro Brook.

3.2.2.3 Ecological Characterization

The site includes two cleared areas surrounded by forest and a narrow strip of riverine vegetation located on the western edge of the site. The two clearings, covered with sandy soil, are sparsely vegetated with grasses and forbs. The area surrounding the clearings is densely vegetated with mixed oaks ranging from 40 to 60 feet in height (LFS 1983).

Surface water runoff from the site generally flows southeast (E & E 1994a) through a narrow riparian wetland associated with Marlboro Brook and vegetated with ash and arrowwood. Marlboro Brook then flows south and southeast to a wetland 1,000 feet downstream of Site A10. Situated on both sides of Marlboro Brook, this wetland is seasonally saturated. River weeds and lilies grow along the edges of this slow-moving body of water (USDOI 1977).

This area provides several different habitats, including upland oak forest, open area, open water, and emergent wetland. Oaks are of major importance to wildlife. Waterfowl, upland gamebirds, songbirds, small mammals, and deer rely heavily on acorns for food (Martin *et al.* 1951). The tannin-rich, slowly-decaying leaves of oaks provide a thick mat for reptiles and amphibians to find food in or use as shelter. Open disturbed areas such as the sandy clearings on this site are of little value to wildlife; lack of vegetation provides very little

shelter or food, thus discouraging small mammals, birds, and browsers from using this area. The area along Marlboro Brook and the forested wetlands downstream of the site combine an abundance of nutrients, diverse woody species, and available water. Consequently, such areas attract an array of aquatic and upland species, as well as species specifically adapted to wetlands.

No sightings of rare, endangered, or threatened species have been documented and no unique habitats have been identified in the general vicinity of the site (NHESP 1992).

3.2.2.4 Site History

Site A11 consists of a leach field originally constructed to service the barracks built in 1942 on the southern part of the Annex. The leach field received sanitary waste from the barracks area, which housed approximately 500 troops during World War II. A facility map from 1944 shows the sewage distribution beds connected to several septic tanks located just to the north of the beds. Whether the buildings in the barracks area were used between 1946 and 1957 is not known because information is unavailable on Annex activities during this period. The barracks area appears relatively unchanged from the war years in a map dated 1955. Most of the barracks and associated buildings were demolished in the early 1960s.

The area containing the leach field was part of a 125-acre parcel leased to the USAF in 1958, primarily to allow Raytheon Corporation to construct several buildings (T104, T106, and Tower 3) in order to fulfill its military contracts. The Raytheon buildings apparently were constructed with separate septic and leach field systems, and were not associated with the Site A11 distribution beds. Before 1962, 40 acres of the leased land were apparently returned by the USAF to the Quartermaster Research and Engineering Center at Natick, thus allowing the leach fields to be connected with the CFHA, constructed in 1962.

Apart from the septic tanks and distribution beds, no buildings, construction, or other activities have been noted for the site area in a review of facility maps, real estate records, and historical files. However, the concrete structures or pads located in the eastern clearing may have been part of a USAF antenna array. Each pad has a brass disk in its center with an arrow indicating magnetic and true north (OHM 1994).

3.2.2.5 Results of Previous Investigations

In 1984, Dames and Moore collected surface water and sediment sample (SW/SED4) at the confluence of drainage from Site A11 and Marlboro Brook. Iron and manganese in the surface water sample exceeded drinking water standards, but were attributed to the naturally high levels of iron and manganese in the area. The sample also contained oil and grease (6,000 μg/L). Sediment samples were found to contain several PAHs, arsenic (30 μg/g), lead (17.7 μg/g), zinc (39.1 μg/g), and oil and grease (1,000 μg/g). The same location was resampled by Dames and Moore in 1985, along with four additional samples upstream and downstream from the site. These samples contained low levels of BNAs in the sediments, but not in the surface water. No PAHs were detected.

In 1992, OHM performed a site investigation that included test pit excavations; removal of an empty 55-gallon drum; soil borings; well installation; and groundwater, surface water, sediment, and soil sampling. During the excavation of two test pits, no buried materials were found, no contamination was visible, and no abnormalities were noted on the radiological meter. All samples taken from the area were analyzed for TCL volatile and semivolatile compounds, TCL pesticide/PCBs, TAL metals, and explosives.

In June 1992, OHM found low concentrations of volatile organics in one downgradient well, OHM-A11-22. These were benzene (3.7 μg/L), toluene (9.7 μg/L), and total xylenes (5.0 μg/L). In addition, arsenic (4.91 μg/L and 8.85 μg/L), iron (626 μg/L and 5,200 μg/L), manganese (1,200 μg/L and 1,700 μg/L), and potassium (2,000 μg/L and 2,290 μg/L) appeared to be elevated in both the June and October samples from this well when compared to the average of the results from the other two wells (OHM-A11-21 and OHM-A11-23). However, iron concentrations in OHM-A11-23, the upgradient well, were close to those in OHM-A11-22, and may represent natural levels for the area.

Metals in the soil were detected at background levels, with the exception of lead (65 μg/g) in drum confirmation soil sample A11CD1. PCB 1254 (0.059 μg/g) was found in Boring A11B2. Metals in subsurface soil were determined to be at background levels.

In the upstream sediment sample A11SD1, DDD (0.023 μg/g) was detected, and in the downstream sediment sample A11SD3, there were elevated concentrations of nearly all metals, including arsenic (32 μg/g) and chromium (14.6 μg/g), when compared to other sediment samples. Two areas on the south end of the southern clearing had rust-colored water seeping from the ground into nearby streams. The upstream surface water sample A11SD4 contained aluminum, arsenic, lead, and manganese.

Removals

In 1992, OHM removed the drum from the northern edge of the site and staged it with other debris at Site P13. The soil beneath the drum was not visibly stained. Lead was found at elevated levels in a drum confirmatory sample. Sediment samples were analyzed for TOC as well as grain size.

3.2.2.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, explosives, and TPHC. Sediment samples were analyzed for TOC as well as for grain size. A summary of Phase II Sampling Activities at Site A11 is provided as Table 3-13.

Table 3-13

PHASE II SAMPLING EFFORTS FOR SITE A11 — LEACHING FIELD

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	3	08/30/93	Samples collected to assess groundwater quality and the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	8	09/23/93	Samples collected to assess the nature of subsurface soils and characterize subsurface contamination in areas downgradient of past site activities.
Surface Waters	2	09/15/93	Surface water and sediment samples were collected to assess surface water quality in nearby streams and investigate the potential for off-site contaminant migration through the surface water pathway.
Sediments	2	09/15/93	See Surface Water Sampling Rationale.
	2	09/15/93	Samples collected for TOC analysis.

Source: Ecology and Environment, Inc. 1994.

Geophysical Investigations

A GPR survey was conducted across both the northern and southern portions of Site A11. A total of 18 lines were run, ten across the northern portion and eight across the southern portion. No significant anomalies identifying subsurface tanks, pipes, or other objects were found in the northern portion of the site. However, a series of buried objects were identified in the loose sand fill that covers the clearing in the southern portion of the Annex. The objects were most likely a series of approximately ten pipes that comprised the sewage distribution system for the leach field located in the clearing. Based on the initial geophysical survey results, subsurface test pits were used to identify the GPR anomalies and investigate subsurface soil contamination. The test pit investigation and preliminary results are further described under "Subsurface Soil Sampling" later in this section.

Groundwater Sampling

The monitoring wells at Site A11 were sampled to characterize groundwater quality and investigate the potential for contaminant migration through the groundwater pathway. All three wells were sampled during the August 1993 round of groundwater sampling. Well OHM–A11–21 is in the southeastern corner of the site, downgradient of the leach field and within the suspected groundwater flow towards Marlboro Brook. Well OHM–A11–22 is also downgradient of the leach field, in the southwestern corner of the clearing and approximately 50 feet east of Marlboro Brook. The third well, OHM–A11–23, is near the entrance to the site, at the intersections of the two access roads connecting Diagonal Road to the northern and southern portions of Site A11. The data were used to determine whether past site activities

have had negative impacts on the groundwater pathway and to assess the potential for off-site contaminant migration. Unlike OHM during their previous sampling, E & E did not filter any of the groundwater samples which were sent for TAL metals analysis.

Subsurface Soil Sampling

Four subsurface sampling test pits were completed at Site A11, two in the northern portion and two in the southern portion. Test pits E3-A11-P01 and E3-A11-P02 were completed in the loose sand covered clearing that comprises the majority of the southern portion of the site. Pit E3-A11-P01 was completed near the southern edge of the clearing to characterize subsurface soil conditions and determine whether contaminants are migrating from the leach field towards Marlboro Brook to the south. The second pit was completed near the northwestern corner of the clearing to determine whether contaminants are migrating west through subsurface soils towards Marlboro Brook.

Test pits E3-A11-P03 and E3-A11-P04 were completed in the northern portion of the area within two cleared areas downgradient and due west of the various structures covering the northeastern part of the site. These pits were completed to investigate whether past activities at any of the structures in the northern portion of Site A11 have affected the subsurface soils in the area.

Eight subsurface soil samples were collected, two from each of the four pits. The samples were collected at the following depths from each pit:

- E3-A11-P01: 1.0 foot and 10.0 feet BGS;
- E3-A11-P02: 1.5 feet and 10.0 feet BGS;
- E3-A11-P03: 1.0 foot and 4.0 feet BGS; and
- E3-A11-P04: 1.5 feet and 6.0 feet BGS.

Four exploratory subsurface pits were also completed at Site A11. The purpose of these pits was to confirm several anomalies identified during the GPR survey conducted earlier. A trench, approximately 40 feet long, was completed in an east-west direction across the center of the loose, sand-covered clearing. The pit verified the existence of a series of ten "Bell and Spigot" leach lines running along the north-south axis of the clearing. The ten red, vitrified-clay leach pipes were the only subsurface objects identified during the extended excavation across the leach field. A second smaller excavation was completed in the east-west direction across the southern edge of the clearing. The pit identified the extent of the leach field and provided further geological information on the nature of the subsurface soils in the area. A third exploratory pit was completed along the access road connecting the buildings in the northern portion to the site entrance just east of Diagonal Road. The pit was completed below the remnants of a storage shed and other metal debris just south of the access road, approximately 75 feet east of Diagonal Road. The fourth exploratory test pit was completed in the clearing just west of the buildings and foundations in the northern portion of Site A11.

No subsurface debris or other significant findings were encountered during either of the northern excavations.

Surface Water and Sediment Sampling

Two surface water and two sediment samples were collected from two locations along Marlboro Brook. All four samples were collected from points in Marlboro Brook where the stream begins to flow southeasterly along the western edge of Site A11. The samples were collected before the stream begins to flow east off Annex property, and before it converges with Hop Brook off the southeastern corner of the Annex.

The first sample location, E3–A11–D01, lies approximately 10 feet downstream of the point where Marlboro Brook passes under Diagonal Road. The location was considered a good place to characterize groundwater flow from the northern portion of the site. It is adjacent to the western portion of the site and receives surface runoff from the northwestern corner of the site near well OHM–A11–23.

The second location, E3–A11–D02, lies at a point immediately downstream from the convergence of Marlboro Brook and the intermittent stream bordering Site A11 to the east. The convergence point is roughly 200 feet southeast of the southernmost corner of Site A11. The location was chosen to characterize surface water quality at the convergence point, before Marlboro Brook receives any runoff or groundwater discharge from Sites P36, A12, and P37. The surface water and sediment data from this location assesses the possibility of off-site contaminant migration.

One sediment sample was collected from each location and sent for TOC analysis. In addition, geotechnical samples were collected from each location and sent for grain size and Atterberg limits analyses. These samples provide further data on the nature of the streambed sediments and their impact upon the potential for contaminant migration through the surface water pathway.

3.2.2.7 Nature and Extent of Contamination

Analysis of unfiltered groundwater sampling results indicate the presence of arsenic and lead at concentrations above Massachusetts Primary Drinking Water MCLs. Lead was detected at concentrations of 23.7 μg/L and 26.6 μg/L in wells OHM–A11-21 and OHM–A11–23, respectively. These levels are greater than the MCL value of 15 μg/L for lead. However, during previous filtered groundwater sampling conducted by OHM, lead was detected in only one well, OHM–A11-22, at concentrations (1.99 μg/L and 1.68 μg/L) significantly below all screening values. Similarly, in OHM's previous filtered samples, arsenic was detected at concentrations ranging from 3.54 μg/L to 8.55 μg/L. These levels are significantly below the arsenic concentrations which were detected during unfiltered sampling conducted by E & E. The maximum arsenic concentration (92.2 μg/L in OHM-A11-23) detected during E & E's sampling was approximately 10 times the largest filtered arsenic concentration. These results support the conclusion that the elevated metals are due to suspended solids present in the groundwater. A summary of detections above preliminary

screening levels is provided in Table 3-14. In addition, a summary of analytical results for all samples collected at Site A11 is provided in Tables 3-15 through 3-18, following Section 3.2.2.8, Conclusions and Recommendations for Site A11.

Aluminum, iron, and manganese were detected in the unfiltered groundwater at concentrations above Massachusetts SMCLs. Aluminum was found at concentrations of 29,000 μg/L and 34,000 μg/L in wells OHM-A11-21 and OHM-A11-23, respectively. These concentrations are approximately 600 times greater than the Massachusetts drinking water SMCLs, based on taste and smell. The highest previously detected concentration of aluminum in OHMs filtered sampling was 247 μg/L. This concentration is still above the aesthetically based SMCL but is significantly less than the unfiltered results. Iron was found at concentrations of 44,000 μg/L and 48,000 μg/L in wells OHM-A11-21 and OHM-A11-23, respectively. The concentrations of iron found in the unfiltered groundwater samples are approximately 160 times the SMCLs for Massachusetts. However, during OHM's filtered sampling, the highest detected concentration fell to 5200 μg/L in well OHM-A11-22. These results suggest that the elevated levels are due to suspended solids in the groundwater. Manganese was also found during E & E's unfiltered sampling at levels ranging from 652 μg/L in well OHM-A11-23 to 903 μg/L in well OHM-A11-21. These levels are approximately 18 times greater than the Massachusetts SMCLs. OHM previously identified manganese as a contaminant of concern after concentrations of 1,200 μg/L and 1,700 μg/L were found in filtered samples from well OHM-A11-22. E & E's unfiltered result for manganese in the water is approximately half of OHM's result and suggests that the levels are consistent with naturally occurring metals. A full comparison of the metals concentrations (aluminum, arsenic, and lead) in filtered and unfiltered samples continues to suggest the elevated levels are most likely due to suspended solids in the groundwater.

A further analysis of the unfiltered results indicates the presence of several explosives in well OHM-A11-22. The explosive 1,3–dinitrobenzene, was detected at a concentration of 3.37 μg/L, approximately three times the EPA Health Advisory screening level of 1 μg/L. However, dinitrobenzene's concentration of 3.37 μg/L is below the EPA Region III RBC of 3.4 μg/L for nitrobenzene in tap water. The explosives 2–, and 4–nitrotoluene, were detected at concentrations (3.22 μg/L and 3.34 μg/L) below their Region III RBC screening levels. All explosives were detected at concentrations below screening levels and do not appear to be a concern at Site A11.

Analysis of subsurface soil samples collected from four test pits at Site A11 indicates the presence of arsenic and several pesticides at concentrations well below any screening levels. No other compounds near screening levels were found at the site and subsurface soils do not appear to be a potential source of concern at Site A11.

Analysis of surface water sample E3-A11-D01 indicates the presence of several metals, one phthalate, and two pesticide derivatives above preliminary screening levels. The sample was collected at a point near where Marlboro Brook passes under Diagonal Road and begins flowing in a southerly direction. The sample location lies approximately 15 feet from the culvert in an area of pooled water where sediment accumulates.

The most significant detection above screening levels is arsenic at a concentration of 440 μg/L. This level is approximately 3,000 times the MA/CWA WQC of 0.14 μg/L for the consumption of fish. Cadmium (8.16 μg/L) was also detected at a concentration above the most restrictive screening level of 1.1 μg/L under the MA/CWA WQC for aquatic life. The level of cadmium also is below a second screening level of 18 μg/L, which is the Region III RBC for tap water. Copper (59.6 μg/L) is another metal which exceeded the MA/CWA WQC screening level of 12 μg/L but is significantly below the Region III RBC screening level of 1,400 μg/L. Iron (130,000 μg/L) and lead (107 μg/L) were detected at concentrations significantly above their MA/CWA WQC screening levels for the protection of aquatic life. The concentration of iron found in the sample was 130 times greater than the screening level of 1,000 μg/L. Lead was found at a concentration approximately 33 times greater than the WA/CWA WQC level of 3.2 μg/L.

Bis(2-ethylhexyl)phthalate was the only BNA compound found in field surface water samples. Its presence is most likely attributable to common laboratory or field contamination and is not considered site related.

The pesticide degradation products DDD and DDE were detected at concentrations above the MA/CWA WQC screening levels for the consumption of fish. DDD (0.097 μg/L) was detected at a concentration approximately 115 times the screening level of 0.00084 μg/L and DDE (0.062 μg/L) was detected at a concentration approximately 100 times the screening level of 0.00059 μg/L.

Analysis of the corresponding sediment sample at E3-A11-D01 indicated the presence of TPHC at a concentration (14.4 μg/L) above the Ontario MOE developed LEL screening value of 2 μg/L. Several pesticides were found at residual levels consistent with historic pest management practices. No other contaminants were detected at levels which would establish a concern at Site A11.

The surface water sample collected at E3-A11-D02 indicated the presence of zinc (146 μg/L) at a concentration just above the most restrictive screening level of 110 μg/L developed under the Massachusetts CWA WQC but significantly below a second screening level of 11,000 μg/L for zinc in tap water (Region III RBC). The sediment sample collected at location E3-A11-D02 indicated the presence of arsenic and several pesticides at concentrations above preliminary screening levels. Arsenic was detected at a concentration of 8.53 μg/L, slightly above the LEL screening level of 6 μg/L developed by the Ontario MOE. The arsenic found is significantly below a second screening level of 85 μg/L, which is an ERM concentration developed by NOAA. The pesticide degradation products, DDD and DDE were detected at concentrations above ERL concentrations developed by NOAA and also slightly above SQC used as screening levels by the EPA and the NYSDEC. The pesticide concentrations were consistent with levels detected throughout other streams in the Annex and are indicative of past widespread spraying practices used across the Annex. The highest pesticide concentration observed in samples from either sampling location is 14 times the screening level.

Table 3-14

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE A11

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency above screen level
GW (μg/L)	Aluminum (U)[1]	--	50	MA SMCL[2]	34,000	OHM-A11-21	3/3
	Arsenic (U)	--	50	MA MCL[3]	92.2	OHM-A11-23	1/3
	Iron (U)	--	300	MA SMCL	48,000	OHM-A11-23	3/3
	Lead (U)	--	15	MA MCL	26.6	OHM-A11-23	2/3
	Manganese (U)	--	50	MA SMCL	903	OHM-A11-21	3/3
	1,3-dinitrobenzene (U)	--	1	EPA Health Advisories	3.37	OHM-A11-22	1/3
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[5]	440	E3-A11-D01	2/2
	Cadmium	5	1.1	MA/CWA WQC[6]	8.16	E3-A11-D01	1/2
	Copper	10	12	MA/CWA WQC[6]	59.6	E3-A11-D01	1/2
	Iron	4810	1,000	MA/CWA WQC[6]	130,000	E3-A11-D01	1/2
	Lead	10.3	3.2	MA/CWA WQC[6]	107	E3-A11-D01	2/2
	Zinc	13.3	110	MA/CWA WQC[6]	146	E3-A11-D02	1/2
	Bis(2-ethylhexyl) phthalate	10	1.8	MA/CWA WQC[5]	2.20(J)	E3-A11-D01	1/2
	DDD	<0.2	.00083	MA/CWA WQC[5]	0.097	E3-A11-D01	1/2
	DDE	<0.2	0.00059	MA/CWA WQC[5]	0.062	E3-A11-D01	1/2
SED (μg/g)	Arsenic	2.03	6	Ontario MOE LEL[7]	8.53	E3-A11-D02	1/2
	Dieldrin	--	0.00002	NOAA ERL[8]	0.016	E3-A11-D02	1/2
	DDD	--	0.002	NOAA ERL	0.057	E3-A11-D02	2/2
	DDE		0.002	NOAA ERL	0.040	E3-A11-D02	2/2
	DDT	--	0.001	NOAA ERL	0.011(K)[9]	E3-A11-D02	2/2
	TPHC	16.6	2	Ontario MOE LEL	14.4	E3-A11-D01	1/2

[1]U = Unfiltered groundwater sample.
[2]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[3]MA MCL = Massachusetts Maximum Contaminant Level.
[4]Reg III RBC = EPA Region III Risk-Based Concentrations.
[5]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for human health regarding consumption of water and fish.
[6]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for aquatic life.
[7]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[8]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.
[9]Result biased high.

Source: Ecology and Environment, Inc. 1994.

3.2.2.8 Conclusions and Recommendations

The concentrations of aluminum, iron, lead and manganese found in the unfiltered groundwater samples are most likely due to suspended solids in the groundwater. The explosives found in well OHM-A11-22 are at concentrations below screening levels. No other contaminants above screening levels were identified during sampling and the groundwater pathway does not appear to pose a concern at the site. No contaminants above any screening levels were found in the subsurface at Site A11 and the soils are not a potential source of contamination.

The elevated arsenic and lead concentrations detected in the surface water at sampling location E3-A11-D01 indicate a contaminant source is discharging into Marlboro Brook. Sample location D01 does not lie directly downgradient of site A11 and most likely receives surface runoff from only portions of the site. Previous sampling results do not suggest that A11 is the source of these specific contaminants. The elevated metals concentrations are most likely an indication of an alternate contaminant source upstream of Site A11. To investigate this possibility and to characterize metals concentrations in Marlboro Brook an additional three to four surface water and sediment samples are recommended upstream of location E3-A11-D01. These samples will characterize surface water and streambed quality of the brook further upstream, and investigate other possible sources of contamination such as the Rocket Range/Railroad Classification Yard (P28) and Inspection Pit (P38).

If an upstream source is identified for the metals concentrations found in Marlboro Brook near Site A11, then no further action would be recommended at the site. If no upstream source is found, then further action may be necessary at Site A11 to attempt to locate a source of the metals found in Marlboro Brook. Further action at Site A11 should be pending the results of investigations at Sites P28 and P38.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-15
Chemical Summary Report For Groundwater
Site: A11
Units: UGL

	Site ID	OHM-A11-21	OHM-A11-22	OHM-A11-23			
	Field Sample ID	MXA11211	MXA11221	MXA11231			
	Sample Date	08/30/93	08/30/93	08/30/93			
Test	Parameter .						
EXPLOSIVES	1,3-Dinitrobenzene	< 1.00	3.37 KC@	< 1.00			
	2-Nitrotoluene	< 1.00	3.22 C	< 1.00			
	4-Nitrotoluene	< 1.00	3.34 C	< 1.00			
TAL METAL	Aluminum	34000 @	1620 @	29000 @			
	Antimony	< 5.00	< 5.00	3.53 J			
	Arsenic	31.8	11.4	92.2 @			
	Barium	158	18.0	97.0			
	Beryllium	1.98 J	0.191 BJ	2.06 J			
	Cadmium	< 5.00	< 5.00	2.81 J			
	Calcium	8300	5730	4110			
	Chromium	72.3	8.00 J	52.0			
	Cobalt	30.9	9.73 J	25.9			
	Copper	45.9	3.73 J	54.6			
	Iron	44000 @	7240 @	48000 @			
	Lead	23.7 @	< 5.00	26.6 @			
	Magnesium	11400	1990	7350			
	Manganese	903 @	879 @	652 @			
	Nickel	63.4	26.2	45.4			
	Potassium	6470	2750	4940			
	Sodium	4900	4960	4200			
	Vanadium	60.5	< 10.0	53.7			
	Zinc	107 K	43.2 B	90.2 K			
TPHC	Total Petroleum Hydrocarbons	< 2000	201 J	< 2000			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: PIT

Table: 3-16
Chemical Summary Report For Subsurface Soils
Site: A11
Units: UGG

	Site ID	E3-A11-P01	E3-A11-P01	E3-A11-P01	E3-A11-P02	E3-A11-P02	E3-A11-P03
	Field Sample ID	EXA11011	EXA11011	EXA11012	EXA11021	EXA11022	EXA11031
	Sample Date	09/22/93	09/23/93	09/23/93	09/23/93	09/23/93	09/23/93
Test	Parameter .						
TAL METAL	Aluminum		5220	6430	5090	4480	2740
	Antimony		0.240 J	0.377 J	0.221 J	0.288 J	0.248 J
	Arsenic	6.81	7.54	7.79	6.53	6.32	4.85
	Barium		13.2	26.9 !	13.6	13.5	11.5
	Beryllium		0.174 J	0.226 J	0.169 J	0.145 J	0.172 JL
	Cadmium		< 0.500	0.319 J	0.222 J	< 0.500	< 0.500
	Calcium		381 J	266 J	291 J	258 J	262 J
	Chromium		9.00	13.2	10.6	7.81	4.61
	Cobalt		5.61	7.21 !	4.83	4.71	3.90
	Copper		6.99	9.12	7.16	6.01	6.05
	Iron		7700	10500	7540	7070	4060
	Magnesium		1650	2420 !	1740	1450	821
	Manganese		179 !	179 !	218 !	237 !	163 !
	Nickel		17.4 !	14.7 !	10.0	10.1	6.45
	Potassium		570	1470 !	680 !	540 K	540 K
	Vanadium		10.1	15.5	10.3	8.93	5.66
	Zinc		15.4 K	20.7 K	16.3 K	14.1 K	29.9
TCL Pest	Endrin Aldehyde		0.004 C	0.003 C	0.007 C	0.007 C	< 0.002
	Methoxychlor		0.014 JC	< 0.020	< 0.020	< 0.020	< 0.020
	P,P-DDT		< 0.002	< 0.002	0.001 JC	0.001 JU	< 0.002
	beta-BHC		< 0.002	< 0.002	0.000 JC	0.000 JC	0.001 JC

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: PIT

Table: 3-16
Chemical Summary Report For Subsurface Soils
Site: A11
Units: UGG

	Site ID	E3-A11-P03	E3-A11-P04	E3-A11-P04			
	Field Sample ID	EXA11032	EXA11041	EXA11042			
	Sample Date	09/23/93	09/23/93	09/23/93			
Test	Parameter .						
TAL METAL	Aluminum	1700	2440	2280			
	Antimony	< 0.500 J	< 0.500 J	0.390 J			
	Arsenic	6.16	7.00	5.50			
	Barium	8.31	8.89	10.5			
	Beryllium	0.126 JL	0.159 JL	0.144 JL			
	Cadmium	< 0.500	0.152 J	< 0.500			
	Calcium	251 J	426 J	264 J			
	Chromium	3.00	3.98	4.69			
	Cobalt	3.14	3.97	3.27			
	Copper	4.69	5.41	8.09			
	Iron	3140	4530	3850			
	Magnesium	575 J	754	900			
	Manganese	88.1	63.6	184 !			
	Nickel	4.48	4.85	6.19			
	Potassium	467 K	515 K	657 !			
	Vanadium	4.90	5.56	6.37			
	Zinc	15.4 K	15.4 K	26.6			
TCL Pest	Endrin Aldehyde	< 0.002	0.003 C	0.005 C			
	Methoxychlor	< 0.020	< 0.020	< 0.020			
	P.P-DDT	< 0.002	< 0.002	< 0.002			
	beta-BHC	< 0.002	< 0.002	0.000 JC			

Source: USAEC IRDMIS Level 3/E & E. 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
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@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 3-17
Chemical Summary Report For Surface Waters
Site: A11
Units: UGL

	Site ID	E3-A11-D01	E3-A11-D02				
	Field Sample ID	WXA11011	WXA11021				
	Sample Date	09/15/93	09/15/93				
Test	Parameter .						
TAL METAL	Aluminum	24000 !	1040 !				
	Arsenic	440 !@#	20.7 !@				
	Barium	122 !	17.9 !				
	Beryllium	3.01 J	< 5.00				
	Cadmium	8.16 !#	< 5.00				
	Calcium	6020	4160				
	Chromium	28.2 K!	2.51 JK				
	Cobalt	41.0 !	13.3 !				
	Copper	59.6 !#	3.88 J				
	Iron	130000 !#	10000 !#				
	Lead	107 !#	3.43 J#				
	Magnesium	1440	1000				
	Manganese	427 !	460 !				
	Nickel	56.9 !	< 10.0				
	Potassium	1580	1010				
	Selenium	2.20 !	< 2.00				
	Sodium	2460	3420				
	Vanadium	226 !	5.17 J!				
	Zinc	110 !	146 !#				
TCL BNA	Bis(2-ethylhexyl)phthalate	2.20 J@	< 10.0				
TCL Pest	P,P-DDD	0.097 C@	< 0.040				
	P,P-DDE	0.062 C@	< 0.040				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 3-18
Chemical Summary Report For Sediments
Site: A11
Units: UGG

Test	Site ID	E3-A11-D01	E3-A11-D02				
	Field Sample ID	DXA11011	DXA11021				
	Sample Date	09/15/93	09/15/93				
Test	Parameter .						
TAL METAL	Aluminum	5430 !	2830				
	Arsenic	4.11 !	8.53 !#				
	Barium	11.5	14.4				
	Beryllium	0.185 JL!	0.190 JL!				
	Calcium	374 J	570 J!				
	Chromium	9.93 !	5.73				
	Cobalt	5.09 !	5.09 !				
	Copper	5.33 L	5.70 L				
	Iron	12200 !	6120				
	Lead	4.64 !	7.00 !				
	Magnesium	227400 !	106400 !				
	Manganese	99.9 !	104 !				
	Nickel	10.8 !	6.07 !				
	Potassium	772	509 K				
	Vanadium	12.0	8.45				
	Zinc	27.4 J!	19.2 J				
TCL Pest	Dieldrin	< 0.002	0.016 C!#				
	P,P-DDD	0.011 C#	0.057 C#				
	P,P-DDE	0.010 C#	0.040 C#				
	P,P-DDT	0.005 KC#	0.011 CK#				
	alpha-BHC	0.001 JC	0.003 JC				
TOC	Total Organic Carbon	5830	33300				
TPHC	Total Petroleum Hydrocarbons	14.4 J#	< 20.0				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

3.2.3 Site A12 — PCB Spill Remediation Area

A routine inspection of Site A12 by Fort Devens personnel in July 1985 identified a PCB transformer leak. The spill area was remediated in 1985 and 1986. A site map is presented in Figure 3–4.

3.2.3.1 Site Location

Site A12 is located in the southern part of the Annex, and on the southern side of Moore Road between Firehouse Road and Diagonal Road. The site is between Sites P36 and P37 and consists of a clear, sloping area. This area was the site of a 1985 PCB spill, on the eastern side of the Raytheon Building T104. There are no other notable features at this site.

3.2.3.2 Physical Characteristics

Site A12 is on the side of a low hill of glacial till covered by glacial outwash identified as a ground moraine by Hansen (1956) and described as a drumlin by Perlmutter (1962). The average surface elevation at the site is approximately 200 feet AMSL. No wells were installed at the site, but water levels collected at Sites P36 and P37, immediately adjacent to the site show the average groundwater elevation to be 182 feet AMSL.

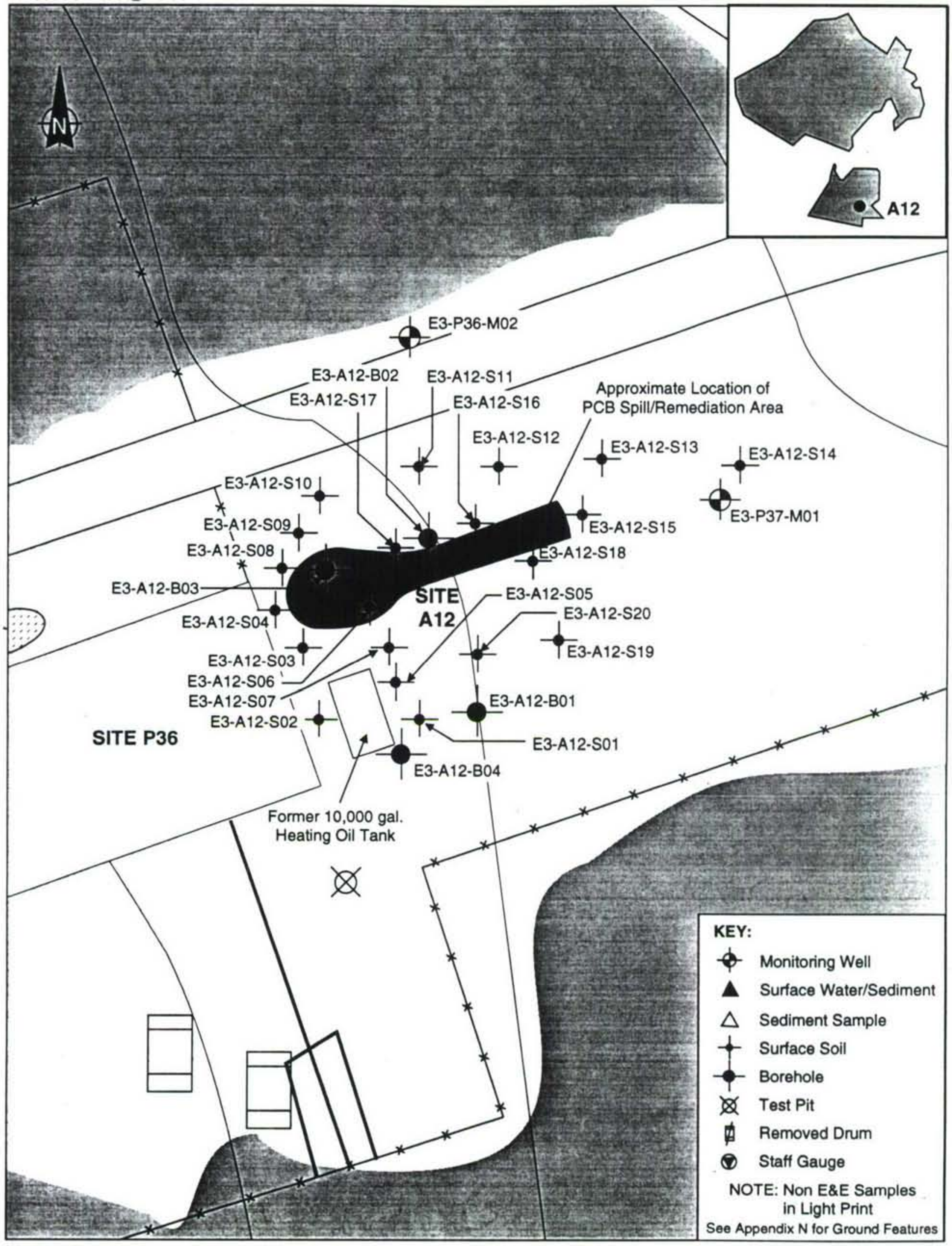
Four boreholes were installed at Site A12 by E & E in 1993. Outwash material consisting of a poorly sorted mixture of sand, silt, and gravel was encountered in each borehole to a depth of 9 feet BGS. The outwash strata were underlain by a tight till made up of clayey silt and gravel. This layer extended to a depth of at least 16 feet BGS, as observed at E3–A12–B03, the deepest of the four borings. A soil sample collected from the 0- to 2-foot interval at borehole E3–A12–B01 was submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as a non-plastic, silty sand. Please refer to Appendix D for complete geotechnical laboratory reports. Bedrock is probably the quartz diorite facies of the Dedham Granodiorite (Hansen 1956). A seismic survey conducted by E & E at Sites P36 and P37 indicated a bedrock elevation of approximately 140 feet AMSL beneath Site A12. A complete geophysical report can be found in Appendix E.

Surface water flows northeast from the site, crossing Site P37 and draining into Marlboro Brook. As mentioned above, no wells were installed at the site; however, based on water levels and hydrogeologic information collected at Sites P36 and P37, groundwater flow is northeast to Marlboro Brook.

3.2.3.3 Ecological Characterization

Site A12 is in the southern part of the Annex between Sites P36 and P37. The ecological survey at these three sites was conducted simultaneously and accordingly discussed in one section. Consequently, please refer to Section 3.2.5.3 for discussion of the ecology at this site.

11: SUDBURY\UC6_A12.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-4 MAP OF SITE A12 PCB SPILL/REMEDIATION AREA

3.2.3.4 Site History

In July 1985, Fort Devens Directorate of Engineering and Housing (DEH) personnel discovered that a transformer staged near Building T104 on the southern part of the Annex had leaked oil containing PCBs. Beginning in 1983, Fort Devens had used the area near Building T104 to stage transformers after their removal from secure storage. This staging area was a place were contractors would pick up, transport, and service or dispose of old transformers. At the time of the spill discovery, four transformers were located in the staging area. Two of the transformers were reportedly emptied sometime prior to the spill, and the remaining two still contained fluid. Transformer labels noted that they contained "pyranol" insulating fluid. After the transformers were removed from secure storage, vandals apparently entered the site and used the transformers for target practice. Bullet holes and dents were noted in the two empty units, and one bullet puncture noted in the leaking transformer probably resulted in the spill (Fort Devens 1985).

When Fort Devens assumed control of the Annex, it was noted that many of the old buildings at the site contained transformers likely to be filled with PCB-containing oil. Thus, it is likely that the transformers at Site A12 came from buildings located at the Annex. At the time of the release, the buildings in the nearby area (T104 and T106) had been unused for at least five years. These buildings were formerly used by the Raytheon Corporation and the Natick Laboratories Air Drop Engineering Laboratory.

An estimated 100 to 200 gallons of PCB oil were released onto the ground. The release ran downgrade and under an asphalt-paved, 4-foot-wide walkway. The walkway led from a parking lot to a building entrance. Fluid was observed to have seeped between cracks and penetrated site soil.

3.2.3.5 Results of Previous Investigations

In July 1985, Inland Pollution Control, Inc. drained the remaining 300 gallons of fluid from the leaking transformer and excavated 150,490 pounds of visibly contaminated soil in the release area. In 1985, AEHA sampled the soil around the contaminated area and detected levels of PCBs (3,492 ppm) from the area of excavation, and up to 508 ppm from the surrounding terrain. Three consecutive soil removals were performed in October and November 1985, which increased the total amount of soil removed to 161 tons. Groundwater was not encountered in excavations. The next round of soil sampling determined that the spill had been remediated to a level of 4 μg/g with a few results of 10 μg/g.

A review of documents pertaining to the removal of material from the PCB Spill and remediation area in 1985 indicated the following were removed: (1) in July 1985 - 300 gallons of PCB oil under Manifest Number MA B117436; 150,490 total pounds of PCB-contaminated soil under manifest number NYA 2578122, NYA2578158, NYA 2578131, and NYA 2578143; four drained transformers under manifest number MA B25781851; and two drums (one oil, one debris) under manifest number MA B117661; (2) in October and November 1985 - a total of 171,570 pounds of PCB-contaminated soil removed and transported under manifest numbers NYA 2025531, NYA 2025126, NYA 205099, NYA

2025117, and NYA 1494423 to the SCA Chemical Services facility in Model City, New York, EPA ID number NYD049836679. The transporter for the October and November removals was Inland Pollution Control, Inc., EPA ID number MAD095869459. Although the manifests for the July 1985 removals are not in E & E site files, given that Inland Pollution Control, Inc. was the remedial contractor hired by the Army in July 1985, they were probably also the transporter for the July 1985 removals, and the likely destination for the contaminated soil removed in October and November 1985 was also the SCA Chemical Services facility in Model City, New York. The exact destination for the removed PCB oil, and the two drums could not be identified.

In May 1986, Fort Devens, in consultation with Massachusetts Department of Environmental Protection (MDEP), collected soil samples in locations outside the original release area but within the area used by the remedial contractor to load and park equipment during the initial response. Additional soil, believed to be contaminated as a result of spillage of contaminated soil during the initial response, was excavated and removed on 19 June 1986. An excavation was conducted 18 July 1986, and extended 100 feet from the initial spill location near Building T104, with a maximum width of 15 feet at the upgradient end and a total of 11.5 cubic yards of soil was removed. Soil samples were collected up to 12 feet BGS after the excavation and analytical results found PCB levels below 4 ppm.

3.2.3.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation at Site A12, with the exception of geotechnical samples, were analyzed for TCL pesticides and PCBs only. One subsurface soil sample was sent for geotechnical analysis to determine grain size. A summary of Phase II Sampling Activities at Site A12 is provided as Table 3-19.

Table 3-19

PHASE II SAMPLING EFFORT FOR SITE A12 — PCB SPILL REMEDIATION AREA

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Subsurface Soils	8	08/10/93 08/11/93	Samples were collected to investigate residual PCB.
Surface Soils	20 (2 to lab)	08/24/93 09/02/93	Samples were collected to investigate residual PCB levels in the surface soils in the vicinity of the PCB spill and soil removal area.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

No groundwater sampling occurred at Site A12. Groundwater quality has been analyzed in conjunction with the adjacent Sites P36 and P37, and is presented in those sections.

Subsurface Soil Sampling

Four borings were completed at the site to investigate subsurface contamination in the area immediately surrounding the past PCB transformer storage and spill location. The borings were placed crossgradient and downgradient of the soil removal area. The sample data characterizes residual levels of PCB contamination in the subsurface soil and investigates the need for further remedial action. Eight samples were collected, as each of the four borings was sampled at two different depths. In addition to full laboratory analysis, each of the eight samples was also screened in the field using the ENSYS PCB RISc Soil Test System. One geotechnical sample was collected at a depth of 0 to 2 feet BGS in boring E2-A12-B01 and sent for grain size and Atterberg limits analyses. The geotechnical sample provides data on the nature of the subsurface soils in the area and their impact upon contamination migration in the groundwater pathway. A description of the methods used and the field screening results are discussed in PCB Field Screening below, as well as individual sample depths and their corresponding borehole location number.

Surface Soil Sampling

Twenty surface soil samples were collected from areas adjacent to and downgradient of the past transformer storage and oil spill area. The samples were collected from areas that had obvious soil discoloration, stressed vegetation, or were lying within surface drainage channels. All samples were field screened using the ENSYS PCB RISc Soil Test System described below. In addition, two samples with positive field screening hits above 10 ppm were sent to a laboratory for confirmation analysis.

E & E QAPjP requirements resulted in rejection of the original soil analyses for E3-A12-S02 and E3-A12-S03.

PCB Field Screening

Field testing of soil from surface and subsurface soil borings was conducted using the ENSYS PCB RISc Soil Test System. The system is based on an immunoassay/photometric detection method developed to qualitatively identify 95 percent of samples that are PCB-free or at concentrations greater than 1 ppm. The system control is established through the use of 1 ppm and 10 ppm standards.

The procedure consists of three phases. Phase 1, Preparation and Extraction of the Sample, involves the weighing, extraction, and filtration of each sample to be tested. Phase 2, Sample and Standard Preparation, involves the quantitative dilution of the samples and

Table 3-20

FIELD TEST RESULTS FOR PCB SCREENING OF SUBSURFACE SOIL SAMPLES

Site ID	Depth (feet)	Standard	Reading	Standard Reading	Conclusion
E3-A12-B01	4	1 ppm	+2.47	-0.02	<01
E3-A12-B01	4	10 ppm	+2.47	-0.02	<10
E3-A12-B01	14	1 ppm	+2.48	-0.02	<01
E3-A12-B01	14	10 ppm	+2.47	-0.02	<10
E3-A12-B02	4	1 ppm	+2.48	-0.00	<01
E3-A12-B02	4	10 ppm	+2.47	-0.00	<10
E3-A12-B02	14	1 ppm	+2.48	-0.00	<01
E3-A12-B02	14	10 ppm	+2.48	-0.00	<10
E3-A12-B03	4	1 ppm	+0.18	-0.02	<01
E3-A12-B03	4	10 ppm	+0.57	-0.02	<10
E3-A12-B03	9	1 ppm	+0.46	-0.02	<01
E3-A12-B03	9	10 ppm	+2.47	-0.02	<10
E3-A12-B04	4	1 ppm	+0.78	-0.01	>01
E3-A12-B04	4	10 ppm	+0.78	-0.01	>10
E3-A12-B04	9	1 ppm	+2.47	-0.01	<01
E3-A12-B04	9	10 ppm	+0.09	-0.01	<10

Source: Ecology and Environment, Inc. 1994.

standards to be used. Phase 3, The Immunoassay, entails incubation, enzyme addition, color development, and photometric measurement of the results. The detection limits of the analysis are based on the types of PCBs present and are shown in Appendix F in Table F-1. The presence of PCBs is determined by comparing the photometer reading of the standard to that of the samples at two dilution levels. Since an inverse relationship exists between PCB concentration and color intensity with this method, the lighter the color the higher the concentration of the PCBs. Accordingly, readings of negative or zero indicate the presence of PCBs. When tested at two different solution concentrations, the relative concentration of the PCBs is determined qualitatively.

At Site A12, four borings were screened using the ENSYS PCB RISc Test System at two depths. The results presented in Table 3-20. Analysis of the results and conclusions indicated that only one boring, E3-A12-B04, at the first sampling depth showed any qualitative level of contamination above 10 ppm. Similarly, field screening was performed for 20 surface soil samples with the results presented in Table 3-21.

Comparison of the results indicate the presence of PCBs above 10 ppm for samples from E3-A12-S02 through E3-A12-S06. To confirm these findings, samples from E3-A12-S02 and E3-A12-S03 were shipped to E & E Analytical Services Center to be analyzed under

Table 3-21

FIELD TEST RESULTS FOR PCB SCREENING OF SURFACE SOIL SAMPLES

Site ID	Standard	Reading	Standard Reading	Conclusion
E3-A12-S01	1 ppm	NR	NR	<1.0
E3-A12-S01	10 ppm	NR	NR	<10.0
E3-A12-S02	1 ppm	NR	NR	>1.0
E3-A12-S02	10 ppm	NR	NR	>10.0
E3-A12-S03	1 ppm	NR	NR	>1.0
E3-A12-S03	10 ppm	NR	NR	>10.0
E3-A12-S04	1 ppm	NR	NR	>1.0
E3-A12-S04	10 ppm	NR	NR	>10.0
E3-A12-S05	1 ppm	NR	NR	>1.0
E3-A12-S05	10 ppm	NR	NR	>10.0
E3-A12-S06	1 ppm	NR	NR	>1.0
E3-A12-S06	10 ppm	NR	NR	>10.0
E3-A12-S07	1 ppm	+2.47	-0.04	<1.0
E3-A12-S07	10 ppm	+2.48	-0.04	<10.0
E3-A12-S08	1 ppm	+2.47	-0.04	<1.0
E3-A12-S08	10 ppm	+2.48	-0.04	<10.0
E3-A12-S09	1 ppm	+0.03	-0.04	<1.0
E3-A12-S09	10 ppm	+0.01	-0.04	<10.0
E3-A12-S10	1 ppm	+0.50	-0.04	<1.0
E3-A12-S10	10 ppm	+2.20	-0.04	<10.0
E3-A12-S11	1 ppm	+1.65	-0.04	<1.0
E3-A12-S11	10 ppm	+2.48	-0.04	<10.0
E3-A12-S12	1 ppm	+2.47	-0.04	<1.0
E3-A12-S12	10 ppm	+2.48	-0.04	<10.0
E3-A12-S13	1 ppm	+2.47	-0.06	<1.0
E3-A12-S13	10 ppm	+2.47	-0.06	<10.0
E3-A12-S14	1 ppm	+2.48	-0.06	<1.0
E3-A12-S14	10 ppm	+2.47	-0.06	<10.0
E3-A12-S15	1 ppm	+2.47	-0.06	<1.0
E3-A12-S15	10 ppm	+2.47	-0.06	<10.0
E3-A12-S16	1 ppm	+0.85	-0.18	<1.0
E3-A12-S16	10 ppm	+2.48	-0.18	<10.0
E3-A12-S17	1 ppm	+2.48	-0.18	<1.0
E3-A12-S17	10 ppm	+2.48	-0.18	<10.0
E3-A12-S18	1 ppm	+2.47	-0.18	<1.0
E3-A12-S18	10 ppm	+2.48	-0.18	<10.0

Table 3-21

FIELD TEST RESULTS FOR PCB SCREENING OF SURFACE SOIL SAMPLES

Site ID	Standard	Reading	Standard Reading	Conclusion
E3-A12-S19	1 ppm	+2.48	-0.02	<1.0
E3-A12-S19	10 ppm	+2.47	-0.02	<10.0
E3-A12-S20	1 ppm	+2.47	-0.02	<1.0
E3-A12-S20	10 ppm	+2.47	-0.02	<10.0

NR = Not recorded.

Source: Ecology and Environment, Inc. 1994.

EPA Method 8080. The results of the analysis of these samples are provided in Table 3-22 and Table 3-23 at the end of Section 3.2.3.8, Conclusions and Recommendations for Site A12.

3.2.3.7 Nature and Extent of Contamination

The purpose of field investigation at Site A12 was to confirm the effectiveness of the remediation of a PCB spill that occurred in 1985. At Site A12, four subsurface borings were conducted and soil samples were collected, and 20 surface soil samples were collected for field screening of PCBs. The surface soil samples were collected in a grid across the PCB spill and remediation area. The subsurface soil samples and two of the surface soil samples, where levels of PCBs were indicated by field screening to be elevated, were sent for laboratory analysis. The results of field screening are included in Section 3.2.3.6, which discusses field work performed at this site. Groundwater sampling was conducted as part of Site P37.

Soil samples from the four soil borings were analyzed for pesticides and PCBs. No pesticides or PCBs were detected in any of these samples above the reporting limits. Laboratory analysis of the two surface soil samples indicated low levels of Arochlor 1260 in both samples up to a concentration of 0.261 μg/g. This level is well below the soil screening value of 2 μg/g used in this study (MCP GW-1/S-1). Several pesticides were detected at trace levels in the surface soil samples, but only methoxychlor (up to 0.092 μg/g) was detected above the highest level in background soils. The levels of these pesticides were well below soil screening values such as 100 μg/g for methoxychlor (MCP GW-1/S-1).

Groundwater sampling at the site (at well E3-P37-M01) and downgradient (at wells E3-P36-M03, E3-P37-M02, and E3-P37-M03) did not detect the presence of any PCB compounds in groundwater. For a full discussion of the groundwater results, please see the appropriate sections under Sites P36 and P37.

Three surface water and sediment samples were taken in Marlboro Brook as part of the investigation of Site P37. Marlboro Brook receives surface water and groundwater drainage from Sites P36, P37, and A12. The elevated detections of arsenic, iron, lead, nickel and several pesticides are unlikely to be related to Site A12, given that these compounds were not found at significantly elevated levels in groundwater at or downgradient from Site A12, or in subsurface or surface soils at Site A12. For a full discussion of the surface water and sediment results, please see the appropriate section under Site P37.

3.2.3.8 Conclusions and Recommendations

Analysis of sampling did not indicate any residual high levels of PCBs in the PCB spill and remediation area. In field screening of 20 soil samples, five samples were chosen as potentially containing PCBs in a concentration greater than 10 μg/g. Two of these five samples were sent for laboratory analysis, in which the highest PCB detection (for Aroclor 1260) was 0.261 μg/g. This level is well below the 2 μg/g soil screening value (MCP GW-1/S-1). The difference in field screening and laboratory analysis reflects the higher degree of confidence in laboratory analysis. No PCBs were detected in four subsurface borings at the site. Analysis of groundwater sampling at the site and downgradient did not identify the presence of PCBs. No PCBs were detected in surface water or sediment sampling downgradient. Thus, sampling results seem to confirm that the remediation in 1985 and 1986 was effective at removing soil containing high levels of PCBs from the site.

A remedial investigation is currently underway for Sites P36, A12, and P37 which have been combined to the RI due to their proximity. Reccomendations for Site A12 will be made following the completion of the RI.

File Type: CSO
Site Type: BORE

Table 3-22
Chemical Summary Report For Subsurface Soils
Site: A12
Units: UGG

	Site ID	E3-A12-B01	E3-A12-B01	E3-A12-B01	E3-A12-B02	E3-A12-B02	E3-A12-B03
	Field Sample ID	BD120101	BX120101	BX120102	BX120201	BX120202	BX120301
	Sample Date	08/11/93	08/11/93	08/11/93	08/11/93	08/11/93	08/10/93
Test	Parameter / Depth	4.0 ft.	4.0 ft.	9.0 ft.	4.0 ft.	9.0 ft.	4.0 ft.
TCL Pest	Endosulfan,A	< 0.001 L	< 0.001 L	< 0.001 L	< 0.001 L	< 0.001 L	< 0.003

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column. U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

File Type: CSO
Site Type: BORE

Table: 3-22
Chemical Summary Report For Subsurface Soils
Site: A12
Units: UGG

	Site ID	E3-A12-B03	E3-A12-B04	E3-A12-B04			
	Field Sample ID	BX120302	BX120401	BX120402			
	Sample Date	08/10/93	08/11/93	08/11/93			
Test	Parameter / Depth	9.0 ft.	4.0 ft.	9.0 ft.			
TCL Pest	Endosulfan,A	< 0.001	< 0.001 L	0.001 BU			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-23
Chemical Summary Report For Surficial Soils
Site: A12
Units: UGG

	Site ID	E3-A12-S02	E3-A12-S03				
	Field Sample ID	SXA12021	SXA12031				
	Sample Date	09/02/93	09/02/93				
Test	Parameter .						
TCL Pest	Methoxychlor	0.018 JC	0.092 U				
	P,P-DDE	0.094 C	0.023 C				
	P,P-DDT	0.190 C	0.062 C				
	PCB-1260	0.163 C	0.261 C				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

3.2.4 Site P28 — Rocket Range/Railroad Classification Yard

Site P28 was originally identified from an undated map, probably from the MOTS period (1952 to 1957), where it was marked as a "rocket range." This map was located by USAEC (formerly USATHAMA) in 1980. In 1993, investigations were expanded to include the railroad classification yard which extend south to include the railroad inspection pit (Site P38). Figure 3-5 is a site map showing the area.

3.2.4.1 Site Location

Site P28 (the Rocket Range) is a rectangular area approximately 1,000 feet long, extending south of Hudson Road along the old railroad track bed. The area is clear of vegetation except for occasional patches of grass. On the western side of the railroad track bed between the unpaved road and the wetland to the east, there are at least 200 yards of insulated wire, partly exposed and partly buried about three inches underground. The buried wire runs north to south along the railroad track bed. The surrounding area is forested. The area that might have been a rocket range at one time extends along the old track bed up to Diagonal Road. The railroad classification yard extends southwesterly from Diagonal Road another 1,800 feet, so that the entire site is approximately 2,800 feet long.

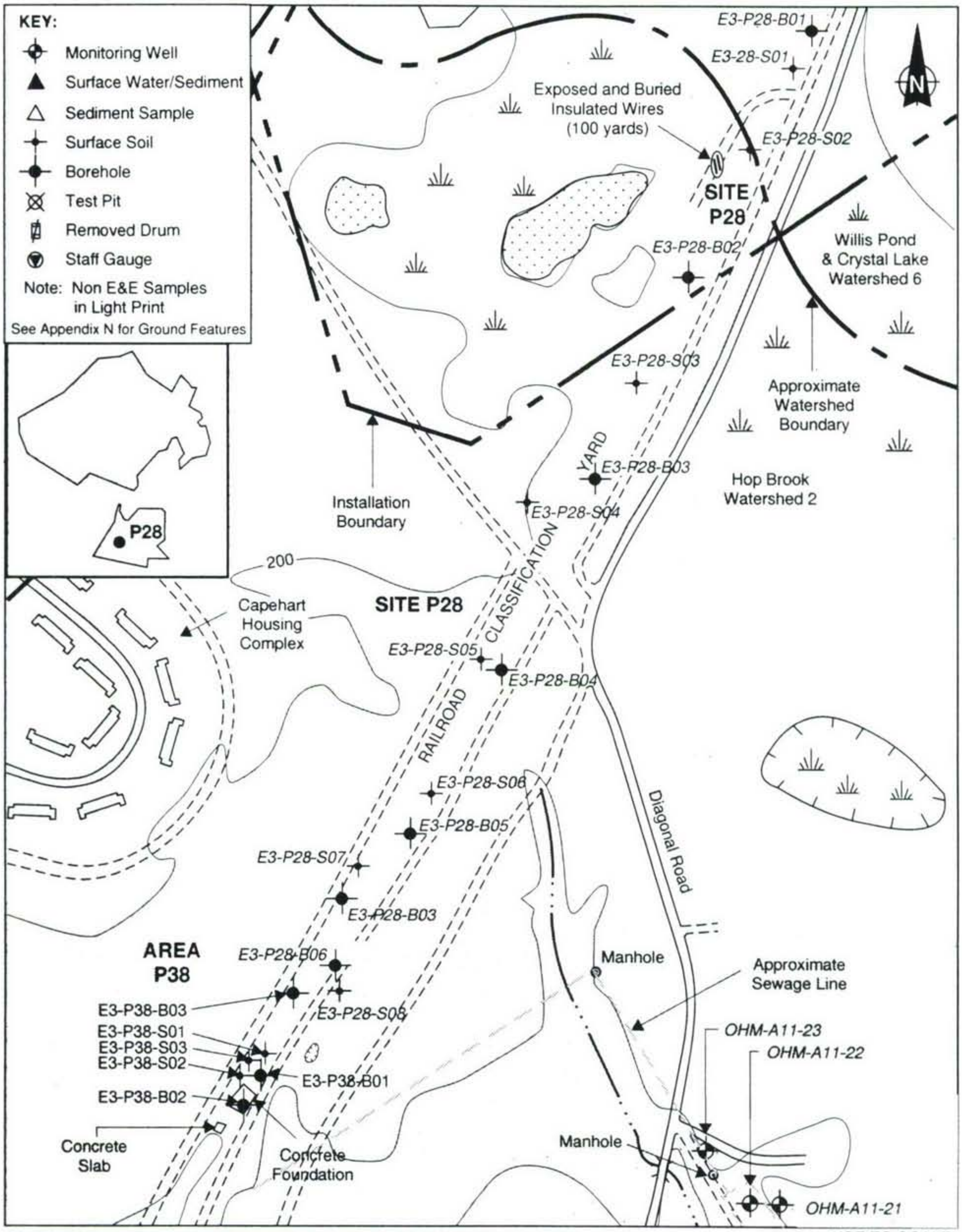
3.2.4.2 Physical Characteristics

Site P28 is on a broad, flat expanse of outwash sand and gravel. The surface elevation across the site is approximately 200 feet AMSL. No wells are located on the site; however, boring logs indicate that groundwater was encountered between 7.5 and 9 feet BGS.

Six borings were installed by E & E in 1993, each to a depth of 11 feet. Outwash material consisting of a poorly sorted mix of sand, silt, and gravel was observed over the entire length of each boring. Surface soil sample E3-P28-S01 was collected by E & E and submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as non-plastic, poorly graded sand. Appendix D contains complete geotechnical laboratory reports. Bedrock was not encountered during subsurface explorations. A seismic survey conducted in the area indicates that Site P28 extends across a former valley of the Assabet River and that bedrock depth varies from 60 feet to greater than 100 feet BGS (Perlmutter 1962). Bedrock is probably amphibolitic schist of the Marlboro Formation (Hansen 1956).

The boundary separating Watershed 6 - Willis Pond and Crystal Lake from Watershed 2 - Hop Brook stretches across the northern portion of the site. The northern third of Site P28 is located in Watershed 6. Surface water at this portion of the site flows both east and west to adjacent wetlands, which ultimately drain to Crystal Lake and Willis Pond. No wells were installed at the site; however, topography and drainage indicate that groundwater at the northern one-third of the site probably flows northeast to Crystal Lake and Willis Pond. Surface water drainage from the southern two-thirds of the site is east and west to adjacent wetlands, which are drained by Marlboro Brook, which flows southeast to Hop Brook. Groundwater flow in this area is also east to tributaries of Hop Brook.

11: SUDBURY\UC6_P28.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-5 MAP OF SITE P28 ROCKET RANGE

3.2.4.3 Ecological Characterization

Vegetation at the site consists of grasses, forbs, and shrubs. Cherry and hardwood trees growing up to 20 feet in height occur beyond the perimeter of Site P28 (LFS 1983).

Since the site is located on a relatively flat area, surface water may flow in several different directions towards many of the surrounding wetlands (E & E 1993). Approximately 200 feet north of the site there is a small permanent open water wetland. Two hundred feet north of this first wetland, there is a much larger, saturated wetland vegetated with evergreen shrubs. Northeast of the site there is another wetland, which is seasonally saturated and overgrown with deciduous trees and shrubs. Finally, approximately 1,500 feet southeast of the site, there is a fourth seasonally saturated wetland overgrown with deciduous trees (USDOI 1977).

This area provides three main habitats: Grassland, cherry-hardwood upland forest, and forested wetland. Areas covered with grasses, forbs, and shrubs provide excellent habitat for deer, ground-nesting birds, small mammals such as mice, and raptors. Small, open bodies of water, such as the one north of the site, provide drinking water, food, breeding areas, and shelter for permanent residents as well as animals that visit regularly from other habitats. Amphibians, reptiles, and waterfowl may all utilize this habitat. The remaining wetlands near the site are forested wetlands, which also attract an array of aquatic and upland species, as well as species specifically adapted to wetlands.

There are no records indicating the presence of rare, threatened, or endangered species, and no unique habitats have been identified in the general vicinity of the site (NHESP 1992).

3.2.4.4 Site History

Site P28 was originally identified from an undated map, likely from the MOTS period (1952 to 1957), that noted the location of a rocket range at this site. The south portion of the Annex was used during the MOTS period by Watertown Arsenal for battle tank testing. Tanks were refurbished at Watertown and then tested at MOTS. No further information on specific testing performed and no corroborating reference regarding the use of explosives or rockets at this site were located.

Historically, the area was used from 1942 until 1964 as part of the railroad classification yard. The railway ceased to be used in 1964, and the track was removed from utility maps published after 1967. Power and lighting lines ran along the west side of the site while the railway was in operation.

In 1958, the Arctic Construction and Frost Effects Laboratory (ACFEL) of the Corps of Engineers requested the use of a 1,500 by 400 foot area on the westerly side of the tracks of the railroad classification yard. The Quartermaster Research and Engineering Command at Natick denied this request, stating that this area "cannot be made available." It is unknown whether this denial is related to another activity that occurred at the site.

In 1967, the Raytheon Company Missile System Division of Bedford, Massachusetts, used a 1,000 by 50 foot area along the roadbed of the classification yard as a low-power radar range in performance of a contract for Redstone Arsenal (Missile Command). This may have occurred in Site P28. In 1971, the site was used by the Mitre Corporation of Bedford, Massachusetts, for three months to conduct moveable seismic array experimentation involving no construction or reported "disfigurement" of the area. This activity was related to a contract with AFSC of Hanscom Air Force Base.

3.2.4.5 Results of Previous Investigations

In 1992, OHM conducted an enhanced area reconnaissance at Site P28 at the area identified as a potential rocket range. No evidence of contamination was noted during the reconnaissance.

3.2.4.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and TPHC. One surface soil sample was analyzed for TOC and another was sent for geotechnical analysis to determine grain size. A summary of Phase II Sampling Activities at Site P28 is provided as Table 3-24.

Table 3-24

PHASE II SAMPLING EFFORTS FOR SITE P28 — ROCKET RANGE/ RAILROAD CLASSIFICATION YARD

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Subsurface Soils	12	08/09/93 08/10/93 12/01/93	Samples were collected to investigate subsurface contamination and the potential for contaminant migration through the groundwater pathway.
Surface Soils	8	08/23/93	Samples were collected to investigate levels of surface soil contamination along the old railroad bed.
	8	08/23/93	Samples were collected and sent for TOC analysis to characterize nature of surface soils at Site P28.
	1	08/23/93	A geotechnical sample was collected to characterize the nature of soils.

Source: Ecology and Environment, Inc. 1994.

Subsurface Soil Sampling

Six borings were completed and twelve samples collected along the old railroad bed, which runs in a northeast-southwest direction across the southern portion of the Annex. The

borings were completed to investigate the presence of subsurface contamination due to past site activities. The borings were completed at approximately 250-foot intervals along the railroad bed. Each boring was drilled to a total depth of 9 feet BGS. Water was encountered at approximately 7.5 feet BGS in borings E3–P28–B01 through E3–P28–B03, which were located in the northern portion of the railroad bed. The borings that were completed in the southern portion of the Annex (E3–P28–B04 through E3–P28–B06) encountered water between 8 and 9 feet BGS. All six borings were sampled by using the split spoon sampling technique at depths between 4 to 6 feet BGS and 9 to 11 feet BGS.

During subsurface drilling, geotechnical samples were collected from the 9 to 11 foot saturated soil interval and sent for grain size and Atterberg limits analyses. Under the requirements of E & E's QAPjP, one sample was collected from the 4 to 6 foot interval and the 9 to 11 foot interval in boring E3–P28–B06 and analyzed for TCL BNAs.

Also as a result of the QA/QC protocols approved in the QAPjP, E & E recollected samples from borehole E3-P28-B06 at the 4 to 6 foot BGS and 9 to 11 foot BGS intervals and analyzed them for TCL BNAs.

Surface Soil Sampling

A total of eight surface soil samples were collected from eight locations near the old railroad bed that runs along the length of Site P28. The sample locations were chosen from areas that had obvious discoloration, stressed vegetation, or were lying in surface drainage channels. The sample data characterizes the surface soils in the area as a potential contaminant source. Samples were collected from each of the locations and sent for TOC analysis. In addition, one surface soil sample, E3–P28–S01, was sent for grain size analysis. The samples provide data to assess the nature of the surface soils in the area and their impact upon potential contaminant migration.

3.2.4.7 Nature and Extent of Contamination

An analysis of the surface soil samples collected the length of the Railroad Classification Yard indicated the presence of several metals above preliminary screening values. Arsenic was found in a sample from E3-P28-S08 at a concentration (4,900 μg/g) significantly above the MCP screening level of 30 μg/g for Level 1 groundwater and Level 1 soils (GW–1/S-1). Arsenic was detected at six other surface soil sampling locations at concentrations above the MCP screening level of 30 μg/g. Arsenic concentrations ranged from 33 μg/g to 4,900 μg/g. The samples containing the two highest concentrations were collected at E3-P28-S06 (330 μg/g) and E3-P28-S08 (4,900 μg/g) located in the southern half of the yard near the former railroad inspection pit. The concentration of arsenic throughout the length of the railroad yard, including the highest at the Annex, suggests a source associated with past railroad activities, possibly herbicide spraying to control weeds. A summary of all detections above preliminary screening levels is provided in Table 3-25. In addition, a summary of all analytical results for Site P28 is provided in Tables 3-26 and 3-27 following Section 3.2.4.8, Conclusions and Recommendations for Site A11.

Table 3-25

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P28

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency above screen level
SOIL (μg/g)	Antimony	0.578	10	MCP GW-1/S-1[1]	120	E3-P28-S08	2/8
	Arsenic	10	30	MCP GW-1/S-1	4,900	E3-P28-S08	7/8
	Beryllium	0.446	0.4	MCP GW-1/S-1	0.421 (J)[2]	E3-P28-S02	1/8
	Thallium	--	8	MCP GW-1/S-1	150	E3-P28-S08	1/8
	Benzo(b) fluoranthene	--	0.7	MCP GW-1/S-1	0.800 (L,J)[3]	E3-P28-S06	1/8
	Chrysene	--	0.7	MCP GW-1/S-1	1.00 (L,J)	E3-P28-S06	1/8
	TPHC	--	500	MCP GW-1/S-1	23,000	E3-P28-S03	1/8

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[2]Value is estimated.
[3]Result biased low, estimated.

Source: Ecology and Environment, Inc. 1994.

Antimony was found in the sample from E3-P28-S08 at a concentration of 120 μg/g, well above the MCP GW-1/S-1 screening level of 10 μg/g. In the sample taken at E3-P28-S06 antimony (32 μg/g) was also found above the GW-1/S-1 screening level. Thallium (150 μg/g) was also found in the sample collected at E3-P28-S08, well above the MCP GW-1/S-1 screening level of 8 μg/g. However, it is only slightly above the MCP screening level of 100 μg/g for Level 3 groundwater and Level 3 soils. Beryllium (0.421 μg/g, estimated) was also found in samples collected at E3-P28-S02 at a concentration below the maximum background beryllium level of 0.446 μg/g. This concentration is just above the MCP GW-1/S-1 screening value of 0.4 μg/g but well below the GW-1/S-3 screening value of 3 μg/g. It is also below the average level of beryllium in soils of the conterminous United States (0.65 μg/L) (Shacklette and Boerngen 1984).

Benzo(b)fluoranthene was found in samples from E3-P28-S06 at a concentration of 0.8 μg/g, slightly above the MCP GW-1/S-1 screening level of 0.7 μg/g. Chrysene was also found in this sample at a concentration of 1.0 μg/g (estimated) which is just above the MCP screening level of 0.7 μg/g.

TPHC (23,000 μg/g) was also detected at one sampling location (E3-P28-S03) at the railroad yard significantly above screening levels. The concentration is 46 times the MCP Level 1 screening level (GW-1/S-1) of 500 μg/g and approximately 5 times the GW-3/S-3 commercial or industrial use screening level of 5,000 μg/g.

Analysis of the subsurface soil samples collected from six borings across the railroad yard showed very low levels of pesticides, arsenic, and in one sample, TPHC. All detected levels were well below any screening values and it appears that surface contamination at the yard has not impacted Site P28's subsurface soils.

3.2.4.8 Conclusions and Recommendations

Due to the proximity of the Inspection Pit (Site P38) and the similarity of sampling results (arsenic in soils) at both Sites P28 and P38, the recommendations for future investigations at Site P38 are included in this section which recommends a combined supplemental site investigation of the arsenic at both sites along the Railroad Classification Yard.

The consistently elevated concentrations of arsenic at Site P28 indicates a potential contaminant associated with past activities at the Rocket Range/Railroad Classification Yard. The recommended scope of the supplemental site investigation includes installation and sampling of one groundwater monitoring well, soil sampling, and surface water/sediment sampling. Surface drainage along the length of the yard from the eastern portion of the Yard drains in an easterly direction but is likely to infiltrate groundwater rather than reach any permanent surface water bodies via surface runoff. However, groundwater from the site is likely to feed nearby surface water drainages. The detection of arsenic in the surface water near Site A11 in Marlboro Brook suggests a possible correlation between the surface contamination at the Rocket Range/Railroad Classification Yard and the detection of arsenic in Marlboro Brook. Antimony and thallium were also elevated at several soil samples. To investigate surface contamination and characterize the water quality of the various wetlands potentially receiving runoff from Site P28 (and Site P38), approximately 23 soil samples should be collected at Site P28 and approximately 13 surface water and sediment samples should be collected from nearby areas.

A total of nine soil samples should be collected over a 3-foot by 3-foot grid around E3-P28-S08 where the highest detection of arsenic was found. In addition, two samples each should be collected from the former railbed north and south of the railyard to assess whether arsenic may be associated with the railroad tracks themselves rather than the classification yard in particular. Approximately five samples each should also be collected from two cross sectional lines perpendicular to the yard at two discrete locations to assess where arsenic is found. The purpose of this soil sampling is not to fully characterize extent, but to identify sources of arsenic at the site.

Because of the size of the Rocket Range/Railroad Classification Yard, it is necessary to collect samples from two Watersheds, 2 and 6. Ten samples from Watershed 2, the major recipient of surface runoff and any groundwater discharge from the site and several sample locations from wetland areas downgradient of surface drainage channels along the eastern edge of the yard would best yield information needed to finish the assessment. Several samples should be collected from Marlboro Brook, upstream of the arsenic contaminated surface water sample at Site A11. The pond which lies in the northeaster portion of the watersheds and appears to be the main recipient of runoff from the middle portions of Site P28 would be a good site to collect samples.

It is recommended that three of the 13 samples be collected from Watershed 6, the catchment basin for the northern portion of the old railroad bed. One sample should be

collected from each of the wetlands which lie on either side of the access road which runs along Site P28. The third sample location should lie in the unnamed intermittent stream as it passes under Hudson Road and flows towards Crystal Lake and the center of Watershed 6.

In addition, the installation of one groundwater monitoring well is recommended along the eastern edge of the Rocket Range/Railroad Classification Yard near the highest detected arsenic concentration (E3-P28-S08). The well would characterize groundwater quality and investigate the effect, if any, of surface contamination upon the groundwater pathway. The monitoring well would determine whether arsenic is in a potentially mobile (soluble) form and whether the arsenic contamination in Marlboro Brook may be due, in part, to groundwater discharge.

File Type: CSO
Site Type: BORE

Table: 3-26
Chemical Summary Report For Subsurface Soils
Site: P28
Units: UGG

Test	Parameter	E3-P28-B01	E3-P28-B01	E3-P28-B01	E3-P28-B02	E3-P28-B02	E3-P28-B03
	Field Sample ID	BD280101	BX280101	BX280102	BX280201	BX280202	BX280301
	Sample Date	08/09/93	08/09/93	08/09/93	08/09/93	08/09/93	08/09/93
	Depth	4.0 ft.	4.0 ft.	9.0 ft.	4.0 ft.	9.0 ft.	4.0 ft.
TAL METAL	Aluminum	5800	5100	5500	5600	4700	3500
	Antimony	0.367 J	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
	Arsenic	6.18	5.16	6.07	5.79	4.12	3.98
	Barium	26.5 !	25.5 !	19.9	14.6	11.3	11.4
	Beryllium	0.232 J	0.231 J	0.228 J	0.232 J	0.203 J	0.161 J
	Cadmium	0.442 J	0.397 J	0.293 J	0.348 J	0.261 J	0.205 J
	Calcium	2000 !	647	907	< 500	< 500	444 J
	Chromium	18.3 K!	12.4 K	10.8 K	10.2 K	11.2 K	6.78 K
	Cobalt	6.68 !	6.36 !	5.48	5.75	4.57	3.54
	Copper	10.2	9.65	9.11	9.80	8.42	5.22
	Iron	10000	9600	8900	8800	9300	5800
	Magnesium	2430 !	2130	1970	1820	1890	1200
	Manganese	290 !	260 !	180 !	200 !	124 !	130 !
	Nickel	16.4 !	14.0 !	11.3 !	15.7 !	10.2	6.81
	Potassium	1270 !	990 !	1020 !	703 !	566	581
	Thallium	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
	Vanadium	11.5	10.2	11.3	9.87	8.40	6.32
	Zinc	36.8	32.8	23.6 K	25.8	15.7 K	12.2 B
TCL BNA	Hexadecanoic Acid						
TCL Pest	P,P-DDT	< 0.004	< 0.004	0.006 C	< 0.004	< 0.004	< 0.004
TPHC	Total Petroleum Hydrocarbons	< 20.0	37.9	< 20.0	< 20.0	< 20.0	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-26
Chemical Summary Report For Subsurface Soils
Site: P28
Units: UGG

	Site ID	E3-P28-B03	E3-P28-B04	E3-P28-B04	E3-P28-B05	E3-P28-B05	E3-P28-B06
	Field Sample ID	BX280302	BX280401	BX280402	BX280501	BX280502	BX280601
	Sample Date	08/09/93	08/09/93	08/09/93	08/09/93	08/09/93	08/10/93
Test	Parameter Depth	9.0 ft.	4.0 ft.	9.0 ft.	6.0 ft.	9.0 ft.	4.0 ft.
TAL METAL	Aluminum	3700	5500	3800	5900	656	3900
	Antimony	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
	Arsenic	5.54	3.65	3.77	6.35	4.85	5.73
	Barium	11.5	13.0	10.1	16.3	4.78 J	14.4
	Beryllium	0.160 J	0.223 J	0.153 J	0.229 J	0.036 J	0.190 J
	Cadmium	0.225 J	0.332 J	0.221 J	0.545 !	< 0.500	0.422 J
	Calcium	372 J	< 500	< 500	352 J	486 J	< 500
	Chromium	7.62 K	13.9 K	8.41 K	12.1 K	< 2.00 K	8.48 K
	Cobalt	4.12	6.24 !	4.37	6.66 !	0.757 J	4.73
	Copper	6.70	6.94	7.70	11.5 !	1.38	6.07
	Iron	7000	8300	6600	11000	857	6600
	Magnesium	1360	1950	1440	2250	207 J	1420
	Manganese	92.5	120 !	64.3	270 !	8.60	260 !
	Nickel	7.47	11.1 !	9.10	15.6 !	1.29	9.34
	Potassium	560	805 !	574	843 !	< 200	684 !
	Thallium	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	0.218 J
	Vanadium	6.94	10.5	7.23	9.78	1.76 J	7.41
	Zinc	15.2 K	17.1 K	16.9 K	22.6 K	3.24 B	12.2 B
TCL BNA	Hexadecanoic Acid						
TCL Pest	P,P-DDT	< 0.004	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
TPHC	Total Petroleum Hydrocarbons	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column. U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-26
Chemical Summary Report For Subsurface Soils
Site: P28
Units: UGG

	Site ID	E3-P28-B06	E3-P28-B07	E3-P28-B07			
	Field Sample ID	BX280602	BXP28071	BXP28072			
	Sample Date	08/10/93	12/01/93	12/01/93			
Test	Parameter Depth	9.0 ft.	0.0 ft.	0.0 ft.			
TAL METAL	Aluminum	4600					
	Antimony	< 0.500					
	Arsenic	7.26					
	Barium	12.3					
	Beryllium	0.187 J					
	Cadmium	0.384 J					
	Calcium	< 500					
	Chromium	10.3 K					
	Cobalt	5.42					
	Copper	7.49					
	Iron	8700					
	Magnesium	1830					
	Manganese	160 !					
	Nickel	11.2 !					
	Potassium	651 !					
	Thallium	< 0.500					
	Vanadium	8.49					
	Zinc	18.2 K					
TCL BNA	Hexadecanoic Acid	0.310					
TCL Pest	P,P-DDT	< 0.010					
TPHC	Total Petroleum Hydrocarbons	< 20.0					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-27
Chemical Summary Report For Surficial Soils
Site: P28
Units: UGG

	Site ID	E3-P28-S01	E3-P28-S02	E3-P28-S03	E3-P28-S04	E3-P28-S05	E3-P28-S06
	Field Sample ID	SX2801X1	SX2802X1	SX2803X1	SX2804X1	SX2805X1	SX2806X1
	Sample Date	08/23/93	08/23/93	08/23/93	08/23/93	08/23/93	08/23/93
Test	Parameter .						
TAL METAL	Aluminum	5220	7520	7180	7790	6550	7430
	Antimony	1.09 K!	0.745 K!	0.510 B!	0.676 B!	< 0.500	32.0 !@
	Arsenic	96.0 !@	83.0 !@	33.0 !@	180 !@	18.0 !	330 !@
	Barium	11.6	30.4 !	19.1	20.3	15.1	20.8
	Beryllium	0.216 J	0.421 J@	0.266 J	0.272 J	0.238 J	0.339 J
	Cadmium	< 0.500	< 0.500	< 0.500	< 0.500	0.213 BJ	< 0.500
	Calcium	390 J	639	415 J	320 J	399 J	< 500
	Chromium	11.5	14.6 !	12.0	13.8	13.0	13.9
	Cobalt	4.78 J	6.11 J	4.86 J	6.87 JK!	5.73 JK	5.12 JK
	Copper	7.12	10.8 !	8.88	10.7	9.48	55.4 !
	Iron	8310	12000	10000	11000	10100	12000
	Lead	7.85 J	5.41 J	7.11 J	6.14 J	5.51 J	55.0 J
	Magnesium	1800	2870 !	2010	2170	1940	1910
	Manganese	147 !	104 !	109 !	137 !	136 !	71.4
	Nickel	9.81	9.71	9.72	12.5 !	11.9 !	8.25
	Potassium	544 K	1950 !	986 !	993 !	684 !	1080 !
	Selenium	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	0.290
	Sodium	< 200	< 200	< 200	37.6 BJ	221 K	147 KJ
	Thallium	0.185 J	< 0.500	0.128 J	0.202 J	< 0.500	2.14
	Vanadium	12.3	19.9	14.7	15.7	14.5	20.2
	Zinc	19.5	19.4	75.7 !	21.1 K	21.0 K	21.4 K
TCL BNA	BEPYR		0.450				
	BJFANT		0.090			0.190	
	Benzo(a)anthracene	< 0.330 L	0.130 JL	< 2.00 L	< 0.330 L	< 0.330 L	< 2.00 L
	Benzo(a)pyrene	< 0.330 L	0.120 JL	< 2.00 L	< 0.330 L	< 0.330 L	< 2.00 L
	Benzo(b)fluoranthene	< 0.330 L	0.290 JL	< 2.00 L	< 0.330 L	0.120 JL	0.800 JL@
	Benzo(ghi)perylene	< 0.330 L	0.080 JL	< 2.00 L	< 0.330 L	< 0.330 L	< 2.00 L

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-27

Chemical Summary Report For Surficial Soils

Site: P28

Units: UGG

	Site ID	E3-P28-S01	E3-P28-S02	E3-P28-S03	E3-P28-S04	E3-P28-S05	E3-P28-S06
	Field Sample ID	SX2801X1	SX2802X1	SX2803X1	SX2804X1	SX2805X1	SX2806X1
	Sample Date	08/23/93	08/23/93	08/23/93	08/23/93	08/23/93	08/23/93
Test	Parameter .						
TCL BNA	Chrysene	< 0.330 L	0.170 JL	< 2.00 L	< 0.330 L	0.093 JL	1.00 JL@
	Fluoranthene	< 0.330 L	0.170 JL	< 2.00 L	< 0.330 L	0.120 JL	0.600 JL
	Indeno(1,2,3-cd)pyrene	< 0.330 L	0.100 JL	< 2.00 L	< 0.330 L	< 0.330 L	< 2.00 L
	Pyrene	< 0.330 L	0.150 JL	< 2.00 L	< 0.330 L	0.120 JL	0.700 JL
TCL Pest	P,P-DDE	0.036 C	0.010 C	0.012 C	< 0.004	0.012 JC	0.230 C!
	P,P-DDT	0.110 JC	0.069 JC	0.035 JC	0.005 JC	0.086 JC	0.680 JC!
TOC	Total Organic Carbon	6780	6340	5510	12600	6070	68300
TPHC	Total Petroleum Hydrocarbons	< 20.0	< 20.0	23000 @	38.0	30.8	44.9

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

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Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-27
Chemical Summary Report For Surficial Soils
Site: P28
Units: UGG

	Site ID	E3-P28-S07	E3-P28-S08				
	Field Sample ID	SX2807X1	SX2808X1				
	Sample Date	08/23/93	08/23/93				
Test	Parameter .						
TAL METAL	Aluminum	7510	6490				
	Antimony	0.720 K!	120 !@				
	Arsenic	130 !@	4900 !@				
	Barium	23.6	15.3				
	Beryllium	0.273 J	0.191 J				
	Cadmium	0.189 BJ	1.94 K!				
	Calcium	< 500	< 500				
	Chromium	15.4 !	8.51				
	Cobalt	7.61 JK!	2.79 JK				
	Copper	13.4 !	6.10				
	Iron	14000 !	7790				
	Lead	6.02 J	140 J				
	Magnesium	2750 !	857				
	Manganese	199 !	69.9				
	Nickel	14.8 !	6.23				
	Potassium	1410 !	332 K				
	Selenium	< 0.200	1.71 !				
	Sodium	< 200	< 200				
	Thallium	0.128 J	150 @				
	Vanadium	17.2	12.1				
	Zinc	23.3 K	33.8 K				
TCL BNA	BEPYR						
	BJFANT						
	Benzo(a)anthracene	< 0.330 L	< 0.330 L				
	Benzo(a)pyrene	< 0.330 L	< 0.330 L				
	Benzo(b)fluoranthene	0.052 JL	< 0.330 L				
	Benzo(ghi)perylene	< 0.330 L	< 0.330 L				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-27
Chemical Summary Report For Surficial Soils
Site: P28
Units: UGG

	Site ID	E3-P28-S07	E3-P28-S08			
	Field Sample ID	SX2807X1	SX2808X1			
	Sample Date	08/23/93	08/23/93			
Test	Parameter					
TCL BNA	Chrysene	< 0.330 L	< 0.330 L			
	Fluoranthene	< 0.330 L	< 0.330 L			
	Indeno(1,2,3-cd)pyrene	< 0.330 L	< 0.330 L			
	Pyrene	< 0.330 L	< 0.330 L			
TCL Pest	P,P-DDE	0.004 JC	0.053 C			
	P,P-DDT	0.025 JC	0.290 JC!			
TOC	Total Organic Carbon	6290	39300			
TPHC	Total Petroleum Hydrocarbons	33.5	41.1			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
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@= Exceeds human health screening value.
!= Exceeds Background.

3.2.5 Site P36 — Former Raytheon Building T104

Site P36 was identified by OHM (OHM 1993) because the building had been used for research and development activity by Raytheon, Inc. Figure 3-6 is a site map detailing the area.

3.2.5.1 Site Location

The Raytheon Building (Building T104) is situated on the southern side of Moore Road in the southern part of the Annex approximately 1,000 feet from the installation boundary. Metal debris is scattered around the entire area of the building. There are two 10–foot wide entrances on the northern side of the building, facing Moore Road. To the west of Building T104, there is a parking lot area containing a drum and other metal debris. In addition, several 3 foot by 3 foot concrete footings and cable anchor blocks for an overturned metal tower are on the ground nearby. On the southern side of the building are mounds of soil and several small depressions. Two old drums and scattered plywood boards also lie in the area south of the building. On the southeastern corner, near the barbed wire fence, is a partially exposed terra cotta pipe. In the same corner, a drain pipe leads from the building to the ground. The area surrounding the building and the parking lot is covered by forest.

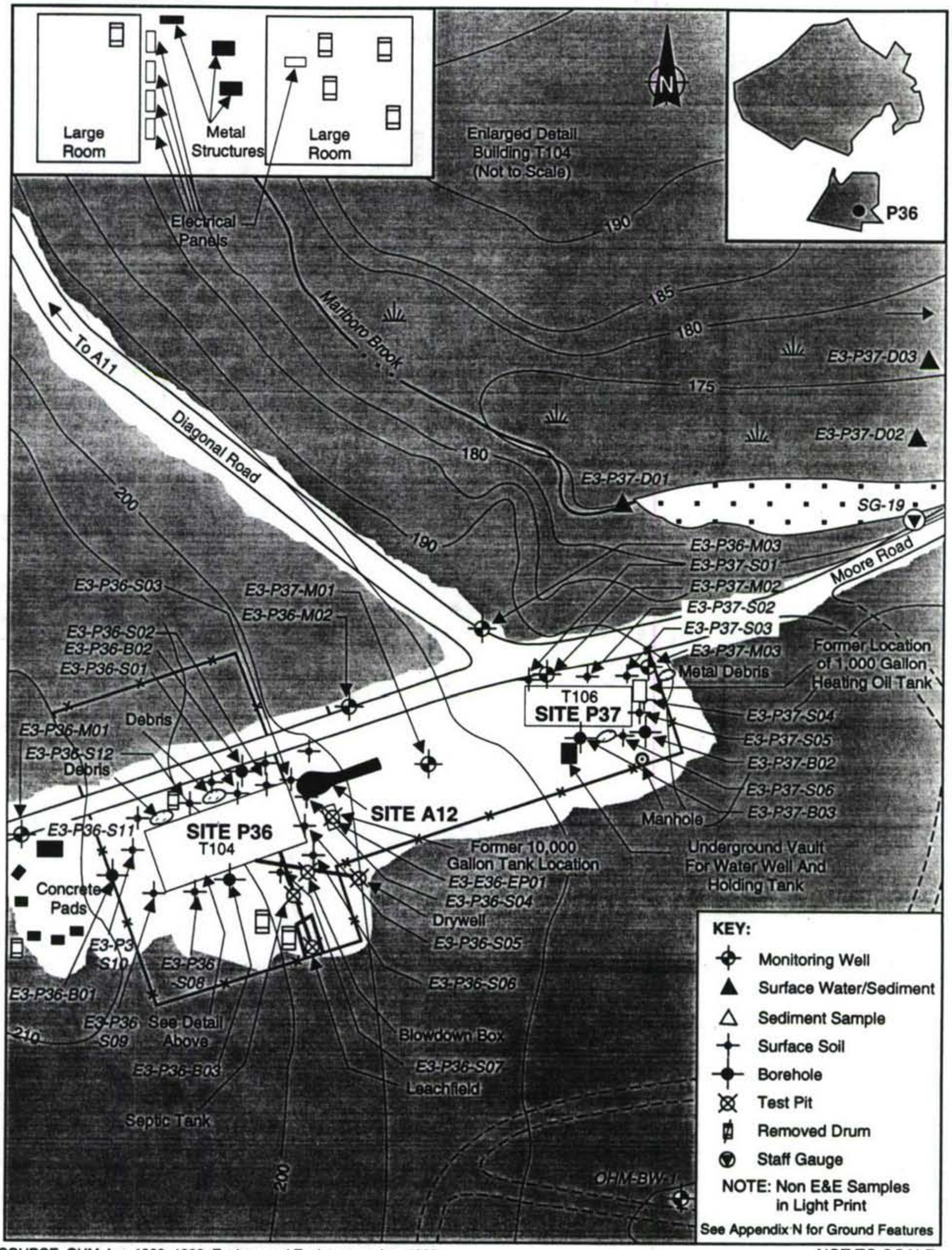
3.2.5.2 Physical Characteristics

Site P36 is on a low hill of glacial till, identified as a ground moraine by Hansen (1956) and described as a drumlin by Perlmutter (1962). Surface elevations at the site range from 195 to 210 feet AMSL. Average groundwater elevations beneath the site range from 186 to 197 feet AMSL.

Three monitoring wells and three boreholes were installed at Site P36 by E & E in 1993. Logs from each of the boreholes and monitoring wells E3–P36–M01 and E3–P36–M02 show 6 to 9 feet of poorly sorted sand and gravel (probably outwash) over tight glacial till consisting of a mix of sand, silt, clay, gravel, and cobbles. The deepest borings reached 18 feet BGS (E3–P36–M01 and E3–P36–M02). A boring at well E3–P36–M03 downgradient of the site near Marlboro Brook, encountered outwash material made up of poorly sorted sand, silt and gravel over the total depth of 19 feet. Soil samples collected from the 9- to 11-foot intervals at borings for wells E3-P36-M01 and E3-P36-M02 were submitted for grain size and Atterberg limits analyses. Both samples were identified as silty sand; however, the sample from well E3-P36-M01 exhibited low plasticity, while the sample from well E3-P36-M02 was non-plastic. A soil sample collected from the 14 to 16 foot interval at well E3-P36-M03 and submitted for grain size and Atterberg limits analyses was subsequently identified as non-plastic, silty sand with gravel. Additional grain size and Atterberg limits analyses were performed on a surface soil sample (E3-P36-S01) collected at the site. This soil was identified as non-plastic, well-graded sand with silt. Appendix D provides complete geotechnical laboratory results.

Bedrock was not encountered during any subsurface explorations. However, interpretation of a seismic survey shows bedrock to be approximately 60 to 70 feet BGS and

11: SUDBURY\UC6_P36.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-6 MAP OF SITE P36 FORMER RAYTHEON BUILDING T104

probably consisting of quartz diorite and gabbrodiorite (Hansen 1956). A seismic survey conducted by E & E at Sites P36 and P37 indicates that bedrock beneath the sites slopes west to east, with bedrock elevations ranging from 170 to 130 feet AMSL (see Figure 3-12, Appendix E). Appendix E contains a complete report on the seismic survey.

Slug tests conducted by E & E in 1993 on each of the three Site P36 monitoring wells yielded a range of transmissivities from 4.34 feet^2 per day to 43.22 feet^2 per day. The aquifer thickness used in each of these calculations was equal to the length of the water column within the well. Wells E3-P36-M01 and E3-P36-M02 were installed at least partially in till and consequently display the lowest transmissivity of 12.45 feet^2 per day and 4.34 feet^2 per day, respectively. E3-P36-M03 was installed completely in outwash, but only yielded a slightly higher transmissivity of 43.22 feet^2 per day. The transmissivities were calculated as follows:

$$T = Kb$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer thickness

Well	K	b	T
E3-P36-M01	4.999	2.490	12.45
E3-P36-M02	0.834	5.200	4.34
E3-P36-M03	9.605	4.500	43.22

All transmissivity calculations may be underestimated due to conservative aquifer thickness approximations. Complete slug test data and interpretation can be found in Appendix G.

Surface water flows east-northeast from the Site across Sites A12 and P37 and into Marlboro Brook. Water levels and hydrogeologic data collected at P36 indicate that groundwater follows topography flowing northeast to Marlboro Brook.

Site P36 is located immediately west of Site A12 and Site P37 and is identical in geology and hydrogeology. Please refer to Sections 3.2.3.2 and 3.2.6.2 for additional geological and hydrogeological information.

3.2.5.3 Ecological Characterization

Sites A12, P36, and P37 are in a developed area on Moore Road in the southern portion of the Sudbury Annex. Site A12 is located between Site P36 on its western side, and Site P37 on its eastern side. In July 1993, E & E conducted a field survey which included

identification of the vegetation cover-types, wetland boundaries, and the plants and animals in the general vicinity of the site. Based on this field survey, five different cover types were identified: four upland plant communities and one wetland community.

Upland communities

Four distinct upland communities were identified in the vicinity of the three sites: open disturbed area; mixed forest; oak forest; and pine plantation. The open disturbed area is located around the abandoned buildings in the center of the site. The eastern portion of this area consists of herbaceous plants such as asters, goldenrods, whorled loosestrife, sweet white clover, various grasses, and cinquefoil. The western portion of this disturbed area is less open and consists primarily of gray birch and fire cherry. However, low blueberry, sweetfern, red oak, paper birch, big tooth aspen, scotch pine, and white pine saplings also occur in this portion of the site. In addition, a few cottonwood trees are scattered along the edges of this disturbed area.

The mixed forest is located in the northeastern portion of the site adjacent to an open-water emergent wetland and primarily includes densely growing white pine, with a few white spruce, red oak, and red pine. The understory consists of overstory saplings, low blueberry, and ironwood. The herbaceous layer is vegetated with Canada mayflower, wood fern, sassparilla, various grasses, bracken fern, and starflower.

Located on the western portion of the site, the oak forest includes red and scarlet oak, as well as some scattered red maple. The relatively dense understory consists of overstory saplings, sweetfern, and low blueberry. A heavy mat of leaf litter covers the ground and limits the herbaceous layer to scattered partridge berry, bracken fern, wood pine, and grasses.

The pine communities are located in the northern and southern edges of this site. Red pines dominate in this community type, but white pine, red oak, and scarlet oak trees are also present. The relatively dense understory includes low blueberry and overstory regeneration. Various mosses, partridge berry, bracken fern, and pink ladyslipper comprise the sparsely vegetated herbaceous layer.

In general, these areas provide both open area and upland forest habitat. Open disturbed areas are of relatively low value to wildlife. Lack of cover and plant diversity discourages many animals. However, this area does provide seeds and berries that may be eaten by several species of songbirds and small mammals. Forested areas similar to the ones in the vicinity of Sites A12, P36, and P37 are valuable to wildlife. Pine seeds, acorns, buds, flowers, and twigs are a source of food for many species of songbirds, upland gamebirds, small mammals, and deer (Martin *et al.* 1951). In addition, the thick mats of leaves provide shelter and food for many insects, amphibians and reptiles. Finally, forested areas provide cover for deer and rabbit particularly in the winter.

Wetland Communities

Topography indicates that surface water in the area flows northeast across the site towards Marlboro Brook. Located approximately 300 feet north and downgradient of the site, there is an open-water emergent wetland, in which the southern end has been dammed to form a small pond or widening of Marlboro Brook. In general, the vegetation is concentrated along the edges of the pond and includes scattered hemlock, speckled alder, red maple saplings and a variety of herbaceous and emergent plants, such as water lilies, cattails, jewelweed, sensitive fern, sedges, slender-leaved iris, boneset, skunk cabbage, and bulrushes. Many snags were observed in the open water area/pond.

The soil underlying the area near the wetland is Montauk muck, a very poorly drained fine silt loam (*Middlesex County Massachusetts Interim Soil Survey Report* 1991). Characteristics observed during the soil analysis included a low matrix chroma (black muck) with no mottles. Areas of inundation, water marks on trees and shrubs, and soil saturation in the upper twelve inches indicate the presence of wetland hydrology.

Open-water wetlands provide drinking water, food, breeding areas, and shelter for both permanent residents as well as animals that regularly visit from other habitats. A variety of amphibians, reptiles, waterfowl, fish, piscivorous birds, and raptors can be found in this type of community. In addition, the emergent vegetation provides cover and food for the wildlife species that frequent this habitat.

Species of Concern

No sightings of rare, endangered, or threatened species have been documented, and no unique habitats have been identified in the general vicinity of these sites (NHESP 1992; Hunt 1992; Butler 1992; Aneptek 1991).

3.2.5.4 Site History

Building T104 was built in 1958 by Raytheon, Inc. originally to fulfill contracts for the USAF. The USAF had obtained a lease for 15 acres in early 1958 that included the land where Buildings T104 and T106 were built in mid-1958, as well as the area around the leach fields at Site A11. Building T104 was built with its own septic system and leach field, and apparently was not connected to the Site A11 leach field. A 10,000-gallon UST was also installed immediately adjacent to the building. Building T104 is a 70-foot by 175-foot metal building. The Raytheon division originally active at the Annex was the Raytheon Equipment Division Surface Radar and Navigation Operation out of Wayland, Massachusetts.

This building, like many at the Annex, has undergone many name changes over its history. Originally known as Building S104 after construction, in internal correspondence between Raytheon and its military points of contact, the building was usually referred to as "Building No. 2." The building was also referred to as "Building S4" and as Building T104.

In response to information requests from USAEC, Raytheon, Inc. did not provide any information on its use of land at the Annex, responding that records are not maintained beyond contract requirements, usually 10 years (USAEC 1993). On the basis of the types of contracts held by Raytheon, Inc. at the Annex, the likely use of Building T104 was for research and development of missile guidance and radar systems and for the manufacture of electronic equipment for defense contracts as a prime and subcontractor.

The site was originally provided to Raytheon for research connected to the Nike-X program under which Raytheon was a major subcontractor to Bell Laboratories. Raytheon assembled and tested the receiver complex for the missile site radar (MSR), part of the Nike-X anti-missile system. Assembly of the MSR receiver was done in T106 and testing was done in radio-frequency shielded rooms in Building T104.

In 1960, participants of a conference between Raytheon, the Boston Air Procurement District, and the Quartermaster Research and Engineering Center (Natick) discussed a request by Raytheon to extend the current lease. The original lease was scheduled to expire in 1961, and it was requested that the lease be extended to 1965. The extension was requested so that Raytheon could continue using facilities for a USAF project titled "Pincushion," involving the testing of a prototype model.

A 1962 map identified Building T104 as the "Shielded Area." A 1964 USAF memo noted that Raytheon was currently working for the Department of the Army on the "Mauler" program as a subcontractor to General Dynamics and was also working under a contract for the Army Material Command. A 1966 memo noted that Raytheon was using the building for testing of the MSR receiver cabinets.

Raytheon apparently did not use the building between early 1968 and July 1969, when it returned to perform work under another contract. In 1971, Raytheon requested continued use of the site to conduct electromagnetic interference tests on the North Atlantic Treaty Organization (NATO) Sea Sparrow Missile Launcher System for a 2-month period in the summer of 1971. The request was addressed to the Army Missile Command at Redstone Arsenal in Alabama. This appeared to be the last use of the building by Raytheon.

Building T104 was designated in 1973 as "S4" for use as "Equipment Research Laboratory Electric." The building was later used by the Aero-Mechanical Engineering Laboratory (also known as the Air Delivery Engineering Laboratory) in conjunction with its use of Building T106 (or S6) and the Equipment Tower No. 3, adjacent to Building T104.

In 1988, the 10,000-gallon underground storage tank attached to Building S104 was removed by ATEC.

3.2.5.5 Results of Previous Investigations

OHM performed an enhanced area reconnaissance in 1992. Two entrances to the building were noted, and metal debris, trash, insulation, and machinery were observed within the building. Large conduits extend from the west end of the building to the former location

of the observation tower, presumably for relaying electric power and/or communications between Building T104 and the observation tower. A number of large vents were noted on the south and west ends of the building. Scrap metal and trash were found throughout the site that are part of the heating, ventilation, and air-conditioning (HVAC) cooling system for Building T104. A large cable, believed to be an anchor for the tower that used to be at the site, was found south of the building, protruding from the ground. No other investigations had been performed prior to the OHM effort.

Removals

In December 1988, Environmental Applications, Inc., removed a 10,000 gallon UST located near the southeastern corner of Building T104. This UST had contained No. 2 Fuel Oil. No visibly contaminated soils or odors were noted. HNu readings of soil samples from the excavation did not indicate readings above background. No holes were observed in the tank and according to the Environmental Applications, Inc. removal document the pit was backfilled with material previously classified as acceptable fill using the soil classification system outlined in its contract with the Army. No other details on backfill material were located.

3.2.5.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and TPHC. In addition, surface soil samples and four subsurface soil samples were analyzed for TOC. Subsurface soil samples were also sent for geotechnical analysis to determine grain size. A summary of Phase II Sampling Activities at Site P36 is provided as Table 3-28.

Groundwater Sampling

To characterize groundwater quality and the potential for contaminant migration, E & E installed, developed, and sampled three shallow overburden monitoring wells in the vicinity of building T104 (Site P36). Placement of all three wells was based on the results of the seismic survey performed during the summer of 1993 and further described in Section 3.2.5.2. All three wells were sampled during both groundwater sampling events in September and December 1993, with both filtered and unfiltered samples collected during each round.

Well E3-P36-M01 is northwest of Building T104 near the northern edge of the paved area that borders Moore Road. The monitoring well was screened across the water table at an interval 8 to 18 feet BGS. The well location monitors the top of the local watershed formed by the low hill of till on which Building T104 stands. It is effectively background with respect to the site.

Table 3-28

PHASE II SAMPLING EFFORT FOR SITE P36 — FORMER RAYTHEON BUILDING T104

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	6	09/01/93 09/02/93 12/01/93	Samples were collected to characterize groundwater quality and assess the potential for contaminant migration in the groundwater pathway.
Subsurface Soils	6 from borings	08/05/93 08/13/93	Samples were collected to assess subsurface contamination.
	1 from 08/13/93 boring	08/13/93	Sample collected for TOC analysis.
	3 from wells	08/05/93 08/06/93 08/07/93 08/13/93	Geotechnical samples were collected to characterize nature of subsurface soils and their impact upon the groundwater pathway.
	3 from wells.	08/05/93 08/06/93 08/07/93	Samples were collected and sent for TOC analysis to characterize nature of subsurface soils and their impact upon the groundwater
Surface Soils	12	08/24/93 08/25/93 09/03/93 12/02/93	Samples were collected to investigate surface soil contamination from areas surrounding building T104.
Surface Soils	12	08/24/93 08/25/93 09/03/93 12/02/93	Samples were collected and sent for TOC analysis to characterize nature of surface soils at the site and their impact upon surface drainage.

Source: Ecology and Environment, Inc. 1994.

Well E3-P36-M02 is located along Moore Road near the northeastern corner of Building T104. The well was screened across the water table at an interval 8 to 18 feet BGS. The relative proximity of the well to Building T104 and Site A12 allows for close monitoring of any contaminant plume emanating from either of the two possible sources. The well characterizes groundwater quality in the area and the potential for off-site contaminant migration. In addition, since the well lies upgradient of Site P37, any contamination found in the groundwater can only be attributed to Sites A12 and P36.

Well E3-P36-M03 is located at the intersection of Diagonal Road and Moore Road and monitors the groundwater pathway downgradient of both Sites A12 and P36. The monitoring well was screened across the water table at an interval 9 to 19 feet BGS. Because it is significantly distant from any possible contaminant sources, the well monitors a relatively large portion of the groundwater pathway migrating from Sites A12 and P36. It is the farthest downgradient well to monitor groundwater quality prior to discharging to Marlboro Brook.

Subsurface Soil Sampling

Six samples were collected, two from each of three borings located near Site P36. The samples were collected from two different depths in each boring. The samples provide data to investigate subsurface contamination and characterize the nature of subsurface soils in the area. Boring E3-P36-B01 was completed in the paved area west of Building T104. Samples were collected from split spoons at depths of 9 to 11 feet BGS and 14 to 16 feet BGS. Boring E3-P36-B02 was completed along the northern edge of Building T104 and sampled with the use of split-spoons at depths between 4 to 6 feet BGS and 9 to 11 feet BGS. The third boring, E3-P36-B03 was completed along the southern edge of T104 and sampled using split spoons at depths between 4 to 6 feet BGS and 9 to 11 feet BGS.

During drilling, geotechnical samples were collected from the saturated zone in each monitoring well and sent for grain size and Atterberg limits analyses. These physical analyses provide data on the types of subsurface soils in the region and their impact upon the groundwater pathway. In addition, during monitoring well installation, a sample was collected from the screened interval in each well and sent for TOC analysis. The samples provide further data on the subsurface soils at the site and help assess the potential for contaminant migration in the groundwater pathway.

Two exploratory pits were completed in the small clearing south of Building T104. The pits verified the accuracy of a blueprint showing the location of a septic tank, blow down box, and leach field, which serviced the former Raytheon building. The sewage system is located southeast of Building T104 in the clearing that runs along the southern edge of the building.

Surface Soil Sampling

Twelve samples were collected from areas surrounding Building T104 in an effort to investigate surface contamination due to past activities at the site. The samples were collected from areas with obvious discoloration and stressed vegetation, or areas lying in surface drainage channels. At each of the twelve locations, an additional sample was collected and sent for TOC analysis. The samples will help characterize the nature of the surface soils in the area and assess the possibility that the soils are potential sources of contamination.

As a result of QA/QC protocols approved under the QAPjP, E & E recollected samples from E3-P36-S10 and E3-P36-S12 in September and December, respectively, and analyzed for BNAs.

3.2.5.7 Nature and Extent of Contamination

The initial concern at Site P36 is that the research activities conducted by Raytheon, Inc., or Natick Laboratories in Building T104 may have resulted in the release of hazardous substances into surrounding media. Potential sources include the residual debris inside the building, a 10,000 gallon UST removed in 1988, and scattered debris and several drums outside the building. Analysis of samples taken at the site indicate a potential concern that a

source of PCBs may be located in Building T104 that has impacted on several areas of soil just outside the building.

Two exploratory pits were excavated at Site P36. The first pit was excavated to confirm that the 10,000 gallon UST located on the east side of the building had, in fact, been removed. This was confirmed. No petroleum odors or discolored soil were observed in the excavated area. No elevated readings were detected with the OVA. The second pit was excavated to the south of the building to locate the blow-down box and the junction box for the leach field, which were indicated on blueprints of Building T104. The blow-down box collects moisture from heating and cooling systems and was confirmed to be underground at a depth of 3 feet approximately 25 feet south of the building. The blow-down box at Building T104 is connected by a pipe extending 30 feet southeast to a dry well located at ground surface at a corner of the fence line. No odors or discoloration were observed in the excavation, and no elevated readings were detected on the OVA. Excavation at this pit also located the junction box for leach field. The junction box is located 10 feet west of the blow-down box. Although the leach field was not uncovered due to equipment failure, the piping from the junction box extends south, where the leach field is likely to be located.

Analysis of an unfiltered groundwater sample from the upgradient well at the site (E3–P36-M01) indicated elevated levels of aluminum (84,000 μg/L), chromium (208 μg/L), iron (86,000 μg/L), lead (24.0 μg/L), manganese (1200 μg/L), and nickel (166 μg/L) above groundwater screening values. These elevated metal levels are due to naturally occurring levels of metals in the till material at this well. In addition, the detection of these metals in this upgradient well were significantly higher than any detection of these metals in downgradient wells at Site P36 or P37. No volatile organics or pesticides were detected in the upgradient well. TPHC were detected at 266 μg/L in the December 1993 sampling round. A summary of all detections at Site P36 above preliminary screening levels is provided in Table 3-29. Additionally, Tables 3-30, 3-31, and 3-32 provide a summary of all analytical data for Site P36. These tables are located following Section 3.2.5.8, Conclusions and Recommendations for Site P36.

Analysis of three downgradient wells (E3-P36-M02, E3-P36-M03, and E3-P37-M01) indicated levels of aluminum, iron, and manganese in unfiltered samples at concentrations above groundwater screening values but below the levels found in the upgradient well. In filtered samples, the only metals found in downgradient wells above groundwater screening values were manganese (104 μg/L) in the E3-P36-M02 well, and aluminum (69.5 μg/L) and manganese (224 μg/L) in well E3-P36-M03. No metals above groundwater screening values were found in the E3-P37-M01 well. The aluminum and manganese levels are probably reflective of naturally occurring levels as indicated by the upgradient well. The antimony detection at well E3-P36-M02 (8.73 μg/L) in the filtered sample was slightly above the screening level of 6 μg/L (SDWA MCL), and is also thought to reflect natural levels. This rationale is supported by the December 1993 filtered results of 4.75 μg/L for well E3-P36-M02. Antimony was not detected above the reporting limit in the unfiltered samples from wells at Site P36 and Site P37 probably due to an interferant in suspended solids.

Table 3-29

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P36

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max Concen-tration	Site ID	Frequency Above Screen Level
GW (µg/L)	Aluminum(U)[1] Aluminum(F)[2]	-- --	50	MA SMCL[3]	84,000 69.5	E3-P36-M01* E3-P36-M03	3/3 1/3
	Chromium(U) Chromium(F)	-- --	100	SDWA MCL[4]	208 <10.0	E3-P36-M01* E3-P36-M02	1/3 0/3
	Iron(U) Iron(F)	-- --	300	MA SMCL	86,000 17.7 (K)[6]	E3-P36-M01* E3-P36-M01	3/3 0/3
	Lead(U) Lead(F)	-- --	15	MA MCL	24.0 <5.00	E3-P36-M01* E3-P36-M02	1/3 0/3
	Manganese(U) Manganese(F)	-- --	50	MA SMCL	1,200 167	E3-P36-M01* E3-P36-M03	3/3 3/3
	Nickel(U) Nickel(F)	-- --	100	MA MCL	166 <10.0	E3-P36-M01* E3-P36-M03	1/3 0/3
SOIL (Sub-surface) (µg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[5]	0.473(est.)	E3-P36-B02	2/3
	Cadmium	0.496	30	MCP GW-1/S-1	64.3	E3-P36-B02	1/3
SOIL (Surface µg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1	0.581(est.)	E3-P36-S09	8/12
	PCB 1260	--	2	MCP GW-1/S-1 (for PCBs)	4.70	E3-P36-S12	3/12
	TPHC	--	500	MCP GW-1/S-1	1,800	E3-P36-S12	2/12

* E3-P36-M01 is located immediately upgradient of Site P36. Concentrations of metals found in this well reflect naturally-occurring metals concentrations in the glacial till underlying the site area adjacent to this well.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
[5]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[6] K = Result biased high.

Source: Ecology and Environment, Inc. 1994.

No pesticides were positively detected in any of the downgradient wells from Site P36. Bis(2-ethylhexyl)phthalate was detected in well E3-P36-M03 at 4.40 μg/L, which is below the screening value of 6 μg/L (SDWA MCL).

TPHC were found at concentrations (287 μg/L in well E3-P36-M02; 531 μg/L in well E3-P36-M03, and 1,290 μg/L in well E3-P37-M01) above the TPHC level in the upgradient well. The TPHC (1,290 μg/L) concentration in well E3-P37-M01 is slightly above the screening value of 1,000 μg/L (MCP GW-1) but is well below the MCP GW-3 value for groundwater not used as drinking water of 5,000 μg/L.

Subsurface borings were conducted at Site P36 on the south, north, and west side of Building T104 to assess if any contaminants are present in subsurface soil in the area immediately outside the building. Borings were conducted as part of the investigation of Site A12 on the eastern side of Building T104, but were only analyzed for pesticides/PCBs, which were not detected. Analysis of soil samples taken from the three borings south, west, and north of Building T104 found only two metals, beryllium and cadmium, above soil screening levels. Beryllium was found up to 0.473 μg/g in boring samples, which is slightly over the highest level in background surface soils of 0.446 μg/g and the soil screening value of 0.4 μg/g (MCP GW-1/S-1). The highest level of beryllium in these borings is well below the MCP GW-3/S-3 soil value of 3 μg/g. Cadmium was found above background levels in only two of six samples from the site, and was above the soil screening value in only one sample. Cadmium was found at the 4 to 6 foot interval in E3-P36-B02 north of Building T104 at 64.3 μg/g which is above the screening value of 30 μg/g, but below the MCP GW-3/S-3 level of 80 μg/g. Other metals were also elevated in some of the boring samples, but none exceeded screening values.

Di-n-octyl phthalate (0.120 μg/g) was detected in one sample at a concentration which suggests that it is an artifact of the field sampling. TPHC were detected at low levels in the two samples from E3-P36-B03, up to a concentration of 15.2 μg/g (estimated), well below the soil screening value of 500 μg/g (MCP GW-1/S-1).

Surface soil samples were taken around the entire perimeter of Building T104 to assess if any surficial contamination may be migrating from the building into surrounding soils. The one concern raised by analysis of these samples was a potential PCB source located within Building T104, as indicated by detection of PCBs in soil samples in areas not thought to be related to the PCB spill and remediation area (Site A12). Concentration of metals were elevated above background in many of the twelve soil samples including cadmium, chromium, cobalt, copper, iron, lead, nickel, and zinc among others. The only metal detected above soil screening values was beryllium (0.581 μg/g, estimated maximum), which is slightly above the highest level in background of 0.446 μg/g and the soil screening value of 0.4 μg/g (MCP GW-1/S-1), but well below the MCP GW-3/S-3 value of 3 μg/g.

PCB 1260 was detected in four of the five soil samples taken on the north side of Building T104 up to a level of 4.70 μg/g (at E3-P36-S12). PCB 1260 was detected in all three samples on the east side of the building up to 1.20 μg/g, although these levels may have been influenced by the adjacent PCB spill and remediation area (Site A12). PCBs were

detected in both samples taken south of the building up to 3.50 $\mu g/g$, with the highest levels coming from a sample taken behind one of the apparent drainage points from inside the building. PCB 1260 was detected in one of two samples taken on the west side of the building at a level of 0.750 $\mu g/g$. The highest levels detected on the north and south sides of the building were above the soil screening value of 2 $\mu g/g$ (MCP GW-1/S-1 and MCP GW-3/S-3 soil value). The pattern of detection indicates a potential source of PCBs may be located inside Building T104.

Several pesticides, including γ-chlordane (up to 0.072 $\mu g/g$), β-endosulfan (up to 0.111 $\mu g/g$), DDT (up to 0.940 $\mu g/g$), DDD (up to 0.097 $\mu g/g$) and DDE (up to 0.084 $\mu g/g$) were detected at levels above the highest level in background soils. None of the pesticides in soils samples at Site P36 were found in concentrations above soil screening values.

Trace levels of several PAHs were detected in one of twelve soil samples. Benzo(b)fluoranthene (0.082 $\mu g/g$, estimated), fluoranthene (0.081 $\mu g/g$, estimated), and pyrene (0.090 $\mu g/g$, estimated) were found in sample E3-P36-S07 at levels well below soil screening values. Butyl benzyl phthalate (0.600 $\mu g/g$, estimated) was detected in one soil sample. No screening value could be found for this compound.

TPHCs were detected in all soil samples in a range from 25.3 $\mu g/g$ to 1,800 $\mu g/g$. Three of the soil samples had TPHC concentrations above 200 $\mu g/g$ and these were all located on the north side of the building. Only one of the soil samples, E3-P36-S12, had a concentration of TPHC (1,800 $\mu g/g$) above the soil screening value of 500 $\mu g/g$ (MCP GW-1/S-1). This sample also had the highest PCB (4.70 $\mu g/g$) detection at Site P36.

Three surface water and sediment samples were taken in Marlboro Brook as part of the investigation of Site P37. Marlboro Brook receives surface water and groundwater drainage from Sites P36, P37, and A12. The elevated detections of arsenic, iron, lead, nickel and several pesticides are unlikely to be related to Site P36, given that these compounds were not found at significantly elevated levels in groundwater downgradient from Site P36, or in subsurface or surface soils at Site P36. For a full discussion of the surface water and sediment results, see Section 3.2.6.7, Nature and Extent of Contamination, Site P37.

3.2.5.8 Conclusions and Recommendations

A remedial investivation is currently underway for Sites P36, A12, and P37, which have been combined for RI due to their proximity. Conclusions regarding Site P36 will be made following the completion of the RI.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-30
Chemical Summary Report For Groundwater
Site: P36
Units: UGL

	Site ID	E3-P36-M01	E3-P36-M01	E3-P36-M01	E3-P36-M01	E3-P36-M02	E3-P36-M02
	Field Sample ID	MFP36011	MFP36012	MXP36011	MXP36012	MDP36021	MFP36021
	Sample Date	09/01/93	12/01/93	09/01/93	12/01/93	09/02/93	09/02/93
Test	Parameter						
TAL METAL	Aluminum	23.6 BJ	20.2 BJ	84000 @	26000 @	3450 @	24.2 BJ
	Antimony	4.88 BJ	4.65 BJ	< 5.00 J	< 5.00	< 5.00 J	< 5.00
	Arsenic	< 2.00	1.31 J	35.2	27.0	2.71	< 2.00
	Barium	6.73 J	7.75 J	561 J	191	32.5 J	5.36 J
	Beryllium	< 5.00	< 5.00	3.96 J	1.12 J	< 5.00	< 5.00
	Cadmium	< 5.00	< 5.00	3.34 J	< 5.00	< 5.00	< 5.00
	Calcium	5290	6400	14400	9750	2510	1970
	Chromium	< 10.0	< 10.0	208 @	73.4	7.44 J	4.00 J
	Cobalt	< 10.0	< 10.0	65.8	18.7	2.82 J	< 10.0
	Copper	< 10.0	4.37 J	182	54.3	5.38 J	< 10.0
	Iron	17.7 BJ	13.5 BJ	86000 @	36000 @	4020 K@	21.8 BJ
	Lead	< 5.00	< 5.00	24.0 @	18.2 @	3.53 J	< 5.00
	Magnesium	874	909	26200 J	7620	1280 J	486 J
	Manganese	124 @	66.2 @	1200 @	424 @	153 @	106 @
	Nickel	< 10.0	18.2	166 @	89.6	< 10.0	< 10.0
	Potassium	1170	1430 B	22000	6990 K	1980	1250
	Selenium	< 2.00	< 2.00	< 2.00 J	1.41 J	< 2.00 J	< 2.00
	Sodium	9660	12300	14000	12200	7250	7220
	Vanadium	< 10.0	< 10.0	187	47.9	6.98 J	< 10.0
	Zinc	13.6 BJ	22.4 K	180	69.6	60.7 K	5.75 BJ
TCL BNA	Bis(2-ethylhexyl)phthalate			< 10.0	< 10.0	< 10.0	
	Diethyl phthalate			< 10.0	48.0	< 10.0	
TPHC	Total Petroleum Hydrocarbons			217 J	266 BJ	< 2000	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-30
Chemical Summary Report For Groundwater
Site: P36
Units: UGL

Test	Parameter	E3-P36-M02	E3-P36-M02	E3-P36-M02	E3-P36-M02	E3-P36-M03	E3-P36-M03
	Field Sample ID	MFP36022	MHP36021	MXP36021	MXP36022	MFP36031	MFP36032
	Sample Date	12/01/93	09/02/93	09/02/93	12/01/93	09/02/93	12/01/93
TAL METAL	Aluminum	24.2 BJ	25.9 B	4050 @	1190 @	69.5 B@	19.4 BJ
	Antimony	4.75 BJ	8.73 B@	2.07 J	< 5.00	4.30 BJ	< 5.00
	Arsenic	1.32 J	< 2.00	3.92	1.84 J	< 2.00	1.01 J
	Barium	< 10.0	4.73 J	35.4 J	15.6	7.65 J	6.54 J
	Beryllium	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
	Calcium	2180	2060	2450	3630	2930	2750
	Chromium	< 10.0	< 10.0	6.71 J	< 10.0	< 10.0	< 10.0
	Cobalt	< 10.0	< 10.0	4.47 J	< 10.0	2.20 J	< 10.0
	Copper	< 10.0	< 10.0	8.04 J	5.90 J	< 10.0	< 10.0
	Iron	< 25.0	< 25.0	5040 K@	1390 @	13.5 BJ	31.1 B
	Lead	< 5.00	< 5.00	< 5.00	3.69 BJ	< 5.00	< 5.00
	Magnesium	500 J	493 J	1460 J	855	807	800
	Manganese	85.7 @	104 @	155 @	114 @	224 @	167 @
	Nickel	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
	Potassium	1210 B	1220	2040	1640 B	866 J	1140 B
	Selenium	< 2.00	< 2.00	< 2.00 J	< 2.00	< 2.00	< 2.00
	Sodium	5330 B	7140	6870	5300 B	5870	8600 K
	Vanadium	< 10.0	3.58 J	10.4	< 10.0	< 10.0	< 10.0
	Zinc	4.73 BJ	18.7 BJ	24.0 B	25.4 K	12.4 BJ	4.90 BJ
TCL BNA	Bis(2-ethylhexyl)phthalate			< 11.0	< 10.0		
	Diethyl phthalate			< 11.0	< 10.0		
TPHC	Total Petroleum Hydrocarbons			< 2000	287 BJ		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-30
Chemical Summary Report For Groundwater
Site: P36
Units: UGL

	Site ID	E3-P36-M03	E3-P36-M03				
	Field Sample ID	MXP36031	MXP36032				
	Sample Date	09/02/93	12/01/93				
Test	Parameter .						
TAL METAL	Aluminum	13000 @	12000 @				
	Antimony	< 5.00 J	< 5.00				
	Arsenic	11.0	9.55				
	Barium	86.4 J	73.5				
	Beryllium	0.546 J	0.533 J				
	Cadmium	2.70 J	< 5.00				
	Calcium	6730	5540				
	Chromium	26.1	20.4				
	Cobalt	15.4	12.9				
	Copper	22.6	22.8				
	Iron	21000 K@	21000 @				
	Lead	6.07	5.58 K				
	Magnesium	5580 J	4980				
	Manganese	553 @	414 @				
	Nickel	30.1	26.0				
	Potassium	4220	4230 B				
	Selenium	< 2.00 J	< 2.00				
	Sodium	7040	9140 K				
	Vanadium	32.7	28.4				
	Zinc	54.3 B	44.7				
TCL BNA	Bis(2-ethylhexyl)phthalate	4.40 J	< 10.0				
	Diethyl phthalate	< 13.0	< 10.0				
TPHC	Total Petroleum Hydrocarbons	< 2000	531 BJ				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-31
Chemical Summary Report For Subsurface Soils
Site: P36
Units: UGG

Test	Parameter / Site ID	E3-P36-B01	E3-P36-B01	E3-P36-B02	E3-P36-B02	E3-P36-B03	E3-P36-B03
	Field Sample ID	BX360101	BX360102	BX360201	BX360202	BX360301	BX360302
	Sample Date	08/05/93	08/05/93	08/05/93	08/05/93	08/13/93	08/13/93
Test	Parameter / Depth	4.0 ft.	14.0 ft.	4.0 ft.	14.0 ft.	4.0 ft.	9.0 ft.
TAL METAL	Aluminum	11000 !	5700	9700	5600	9900	6500
	Arsenic	4.25	3.83	4.84	2.84	7.20	5.71
	Barium	46.5 !	23.4	43.9 !	23.4	47.5 !	29.2 !
	Beryllium	0.454 J!@	0.254 J	0.473 J!@	0.262 J	0.398 J	0.298 J
	Cadmium	7.77 !	0.421 J	64.3 !@	0.417 J	< 0.500	< 0.500
	Calcium	680	807	504 J	795	857	1350 !
	Chromium	19.2 K!	10.6 K	14.7 K!	10.5 K	17.3 !	12.6
	Cobalt	7.71 !	4.56	6.39 !	4.19	7.77 !	5.66
	Copper	12.3 !	17.8 !	14.4 !	8.47	15.6 !	11.7 !
	Iron	15000 !	9000	14000 !	9500	15000 !	12000
	Magnesium	3650 !	1840	2290	1500	2930 !	1890
	Manganese	140 !	92.1	160 !	120 !	163 !	120 !
	Nickel	14.7 J!	7.88 J	10.1 J	6.81 J	13.5 J!	10.6 J
	Potassium	2640 !	1460 !	1970 !	1190 !	2390 !	1700 !
	Thallium	0.204 J	< 0.500	0.182 J	< 0.500	0.233 J	0.148 J
	Vanadium	24.2	13.8	19.8	11.8	24.6	19.6
	Zinc	24.6 K	13.2 K	21.6 K	24.3 K	76.2 !	28.8
TCL BNA	Di-n-octyl phthalate	0.120 J	< 0.330	< 0.330	< 0.330	< 0.330	< 0.330
TCL VOA	12DCD4						0.047
TOC	Total Organic Carbon					4450	2090
TPHC	Total Petroleum Hydrocarbons	< 20.0	< 20.0	< 20.0	< 20.0	12.8 J	15.2 J

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-31
Chemical Summary Report For Subsurface Soils
Site: P36
Units: UGG

	Site ID	E3-P36-M01	E3-P36-M02	E3-P36-M03			
	Field Sample ID	BX3601X1	BX3602X1	BX3603X1			
	Sample Date	08/05/93	08/06/93	08/07/93			
Test	Parameter Depth	9.0 ft.	9.0 ft.	14.0 ft.			
TAL METAL	Aluminum						
	Arsenic						
	Barium						
	Beryllium						
	Cadmium						
	Calcium						
	Chromium						
	Cobalt						
	Copper						
	Iron						
	Magnesium						
	Manganese						
	Nickel						
	Potassium						
	Thallium						
	Vanadium						
	Zinc						
TCL BNA	Di-n-octyl phthalate						
TCL VOA	12DCD4						
TOC	Total Organic Carbon	14300	13500	12700			
TPHC	Total Petroleum Hydrocarbons						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
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Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-32
Chemical Summary Report For Surficial Soils
Site: P36
Units: UGG

Test	Site ID	E3-P36-S01	E3-P36-S01	E3-P36-S02	E3-P36-S03	E3-P36-S04	E3-P36-S05
	Field Sample ID	SD3601X1	SX3601X1	SX3602X1	SX3603X1	SX3604X1	SX3605X1
	Sample Date	08/25/93	08/25/93	08/25/93	08/25/93	08/25/93	08/25/93
Test	Parameter .						
TAL METAL	Aluminum	5740	5860	6640	7900	10500 !	13000 !
	Antimony	5.39 !	6.09 !	4.33 !	< 0.500	< 0.500	< 0.500
	Arsenic	13.0 !	15.0 !	6.78	8.71	7.40	9.78
	Barium	150 !	250 !	14.9	26.6 !	40.7 !	37.6 !
	Beryllium	0.248 J	0.285 J	0.231 J	0.386 J	0.449 J!@	0.499 J!@
	Cadmium	4.83 !	4.60 !	1.38 K!	0.228 BJ	2.90 !	0.377 BJ
	Calcium	2070 !	2040 !	< 500	1000	872	465 J
	Chromium	35.4 !	40.5 !	23.8 !	15.2 !	16.7 !	16.8 !
	Cobalt	20.9 K!	21.3 K!	16.8 K!	7.43 K!	7.90 K!	7.92 K!
	Copper	93.8 !	94.9 !	36.9 !	15.6 !	46.3 !	14.5 !
	Iron	67000 !	58000 !	66000 !	12000	14000 !	15000 !
	Lead	230 !	290 !	90.0	15.0	18.0	7.60
	Magnesium	3440 !	3130 !	1750	3120 !	2680 !	2440 !
	Manganese	362 !	331 !	209 !	146 !	143 !	120 !
	Nickel	45.9 !	41.2 !	30.1 !	14.0 !	12.8 !	12.9 !
	Potassium	860 !	990 !	636 !	1400 !	1700 !	1480 !
	Sodium	577	500	< 200	< 200	103 BJ	112 BJ
	Thallium	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
	Vanadium	32.1	30.6	25.5	22.7	22.5	23.6
	Zinc	1400 K!	1100 K!	1500 K!	150 K!	690 K!	55.7 K!
TCL BNA	23346B			0.100		0.160	
	23445B					0.200	
	244PCB					0.230	
	25HXCB					0.190	
	Benzo(b)fluoranthene	< 3.00 L	< 3.00 L	< 0.330 L	< 0.330 L	< 0.330 L	< 0.330 L
	Butyl benzyl phthalate	< 3.00 L	0.600 KJL	< 0.330 L	< 0.330 L	< 0.330 L	< 0.330 L
	CL4BP					0.150	

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Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-32
Chemical Summary Report For Surficial Soils
Site: P36
Units: UGG

	Site ID	E3-P36-S01	E3-P36-S01	E3-P36-S02	E3-P36-S03	E3-P36-S04	E3-P36-S05
	Field Sample ID	SD3601X1	SX3601X1	SX3602X1	SX3603X1	SX3604X1	SX3605X1
	Sample Date	08/25/93	08/25/93	08/25/93	08/25/93	08/25/93	08/25/93
Test	Parameter .						
TCL BNA	CL6BP					0.290	
	Fluoranthene	< 3.00 L	< 3.00 L	< 0.330 L	< 0.330 L	< 0.330 L	< 0.330 L
	Pyrene	< 3.00 L	< 3.00 L	< 0.330 L	< 0.330 L	< 0.330 L	< 0.330 L
TCL Pest	Endosulfan,B	0.047 C!	0.055 C!	0.017 C!	< 0.002	0.031 C!	0.002 JU
	P,P-DDD	0.059 U	0.058 U	0.016 U	0.010 U	0.013 U	0.004 U
	P,P-DDE	0.013 JU	0.038 JU	< 0.002	0.008 C	< 0.002	0.004 C
	P,P-DDT	0.480 C!	0.510 C!	< 0.002	0.037 C	< 0.002	0.037 C
	PCB-1260	1.90 C	2.20 C@	0.610 C	< 0.020	1.20 C	0.090 C
	alpha-Chlordane	0.013 JC	0.023 JC	< 0.002	< 0.002	< 0.002	< 0.002
	gamma-Chlordane	0.051 C!	0.058 C!	0.033 U!	0.000 JU	0.058 U!	0.002 JU
TOC	Total Organic Carbon	38600	42600	18100	19300	9710	17000
TPHC	Total Petroleum Hydrocarbons	960 @	920 @	122	30.1	83.1	42.6

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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Table: 3-32
Chemical Summary Report For Surficial Soils
Site: P36
Units: UGG

	Site ID	E3-P36-S06	E3-P36-S07	E3-P36-S07	E3-P36-S08	E3-P36-S09	E3-P36-S10
	Field Sample ID	SX3606X1	SX3607X1	SX3607X1	SX3608X1	SX3609X1	SX3610X1
	Sample Date	08/25/93	08/24/93	08/25/93	08/25/93	08/25/93	08/25/93
Test	Parameter						
TAL METAL	Aluminum	8580	12000 !		10800 !	14000 !	13000 !
	Antimony	< 0.500	< 0.500		0.532 BJ!	< 0.500	1.01 K!
	Arsenic	6.17	7.97		7.77	6.89	8.70
	Barium	27.1 !	38.1 !		43.0 !	58.8 !	38.2 !
	Beryllium	0.390 J	0.504 J!@		0.471 J!@	0.581 J!@	0.526 J!@
	Cadmium	0.520 BJ!	0.794 B!		0.424 BJ	15.3 !	1.74 K!
	Calcium	985	542 J		394 J	4710 !	550 J
	Chromium	14.6 !	18.3 !		17.3 !	19.9 !	73.3 !
	Cobalt	8.04 K!	7.90 K!		7.69 K!	8.34 K!	9.13 K!
	Copper	18.6 !	37.0 !		37.5 !	18.6 !	21.6 !
	Iron	13000 !	14000 !		18000 !	17000 !	20000 !
	Lead	25.0	50.0		70.0	20.0	45.0
	Magnesium	2800 !	2410 !		2400 !	3440 !	2340 !
	Manganese	163 !	134 !		125 !	170 !	178 !
	Nickel	11.9 !	13.3 !		14.1 !	15.5 !	13.8 !
	Potassium	1240 !	1330 !		1700 !	2140 !	1410 !
	Sodium	201 KJ	170 KJ		181 KJ	110 BJ	122 BJ
	Thallium	< 0.500	0.149 J		< 0.500	< 0.500	< 0.500
	Vanadium	23.0	30.8		31.1	30.1	30.4
	Zinc	410 K!	290 K!		830 K!	2300 K!	630 K!
TCL BNA	23346B						
	23445B		0.110				
	244PCB		0.120				
	25HXCB						
	Benzo(b)fluoranthene	< 0.330 L	0.082 JL		< 0.330 L	< 0.330	
	Butyl benzyl phthalate	< 0.330 L	< 0.330 L		< 0.330 L	< 0.330	
	CL4BP						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-32
Chemical Summary Report For Surficial Soils
Site: P36
Units: UGG

	Site ID	E3-P36-S06	E3-P36-S07	E3-P36-S07	E3-P36-S08	E3-P36-S09	E3-P36-S10
	Field Sample ID	SX3606X1	SX3607X1	SX3607X1	SX3608X1	SX3609X1	SX3610X1
	Sample Date	08/25/93	08/24/93	08/25/93	08/25/93	08/25/93	08/25/93
Test	Parameter .						
TCL BNA	CL6BP		0.270				
	Fluoranthene	< 0.330 L	0.081 JL		< 0.330 L	< 0.330	
	Pyrene	< 0.330 L	0.090 JL		< 0.330 L	< 0.330	
TCL Pest	Endosulfan,B	0.004 U		0.072 C!	0.002 JU	< 0.002	0.019 U!
	P,P-DDD	0.007 U		0.097 U!	0.022 C	< 0.002	0.063 U
	P,P-DDE	0.011 C		0.084 C	0.080 U	0.005 C	0.047 C
	P,P-DDT	< 0.002		0.940 C!	0.076 C	0.005 C	0.190 C
	PCB-1260	0.169 C		3.50 C@	0.166 C	< 0.020	0.750 C
	alpha-Chlordane	0.001 JU		< 0.002	0.002 JU	< 0.002	0.001 JU
	gamma-Chlordane	0.003 U		0.072 U!	0.002 C	< 0.002	0.011 U!
TOC	Total Organic Carbon	21400	34600		16100	8430	58700
TPHC	Total Petroleum Hydrocarbons	25.3	101		110	46.0	64.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-32
Chemical Summary Report For Surficial Soils
Site: P36
Units: UGG

	Site ID	E3-P36-S10	E3-P36-S11	E3-P36-S12	E3-P36-S12		
	Field Sample ID	SX3610X1	SX3611X1	SX3612X1	SXP36122		
	Sample Date	09/03/93	08/25/93	08/25/93	12/02/93		
Test	Parameter						
TAL METAL	Aluminum		9700	10700 !			
	Antimony		< 0.500	0.399 BJ			
	Arsenic		6.38	7.46			
	Barium		39.1 !	35.9 !			
	Beryllium		0.425 J@	0.472 J!@			
	Cadmium		0.411 BJ	0.713 B!			
	Calcium		740	566			
	Chromium		15.8 !	17.2 !			
	Cobalt		7.04 K!	9.63 K!			
	Copper		15.8 !	22.1 !			
	Iron		12000	15000 !			
	Lead		18.0	55.0			
	Magnesium		2770 !	2440 !			
	Manganese		132 !	221 !			
	Nickel		11.9 !	15.3 !			
	Potassium		1880 !	1210 !			
	Sodium		92.3 BJ	< 200			
	Thallium		< 0.500	< 0.500			
	Vanadium		24.2	36.3 !			
	Zinc		70.2 K!	800 K!			
TCL BNA	23346B						
	23445B						
	244PCB						
	25HXCB						
	Benzo(b)fluoranthene	< 0.330	< 2.00	< 8.00	< 2.00		
	Butyl benzyl phthalate	< 0.330	< 2.00	< 8.00	< 2.00		
	CL4BP						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
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@= Exceeds human health screening value.
!= Exceeds Background.

Table: 3-32
Chemical Summary Report For Surficial Soils
Site: P36
Units: UGG

	Site ID	E3-P36-S10	E3-P36-S11	E3-P36-S12	E3-P36-S12		
	Field Sample ID	SX3610X1	SX3611X1	SX3612X1	SXP36122		
	Sample Date	09/03/93	08/25/93	08/25/93	12/02/93		
Test	Parameter .						
TCL BNA	CL6BP						
	Fluoranthene	< 0.330	< 2.00	< 8.00	< 2.00		
	Pyrene	< 0.330	< 2.00	< 8.00	< 2.00		
TCL Pest	Endosulfan,B		0.007 C!	0.111 C!			
	P,P-DDD		0.007 U	0.060 U			
	P,P-DDE		0.005 C	0.031 C			
	P,P-DDT		0.041 C	0.670 C!			
	PCB-1260		0.251 C	4.70 C@			
	alpha-Chlordane		0.000 JU	0.001 JU			
	gamma-Chlordane		0.008 U!	0.051 U!			
TOC	Total Organic Carbon		13800	31500			
TPHC .	Total Petroleum Hydrocarbons		302	1800 @			

Source: USAEC IRDMIS Level 3/E & E. 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

3.2.6 Site P37 — Building T106 UST

3.2.6.1 Site Location

Site P37 was identified by OHM in 1992, because of the UST in Building T106. The site is depicted in Figure 3-7.

Building T106 is near the intersection of Moore Road and Diagonal Road in the southern part of the Annex, northeast of Building T104 (Site P36) and the PCB remediation area (Site A12). The building is partially surrounded by broken fencing. Metal, wood, and plastic debris can be seen inside through an opening on the western side of the building. On the southern side of the building, there is more metal debris and a manhole. Beyond the fence on the eastern and the southern side of the building, the terrain is covered by forest.

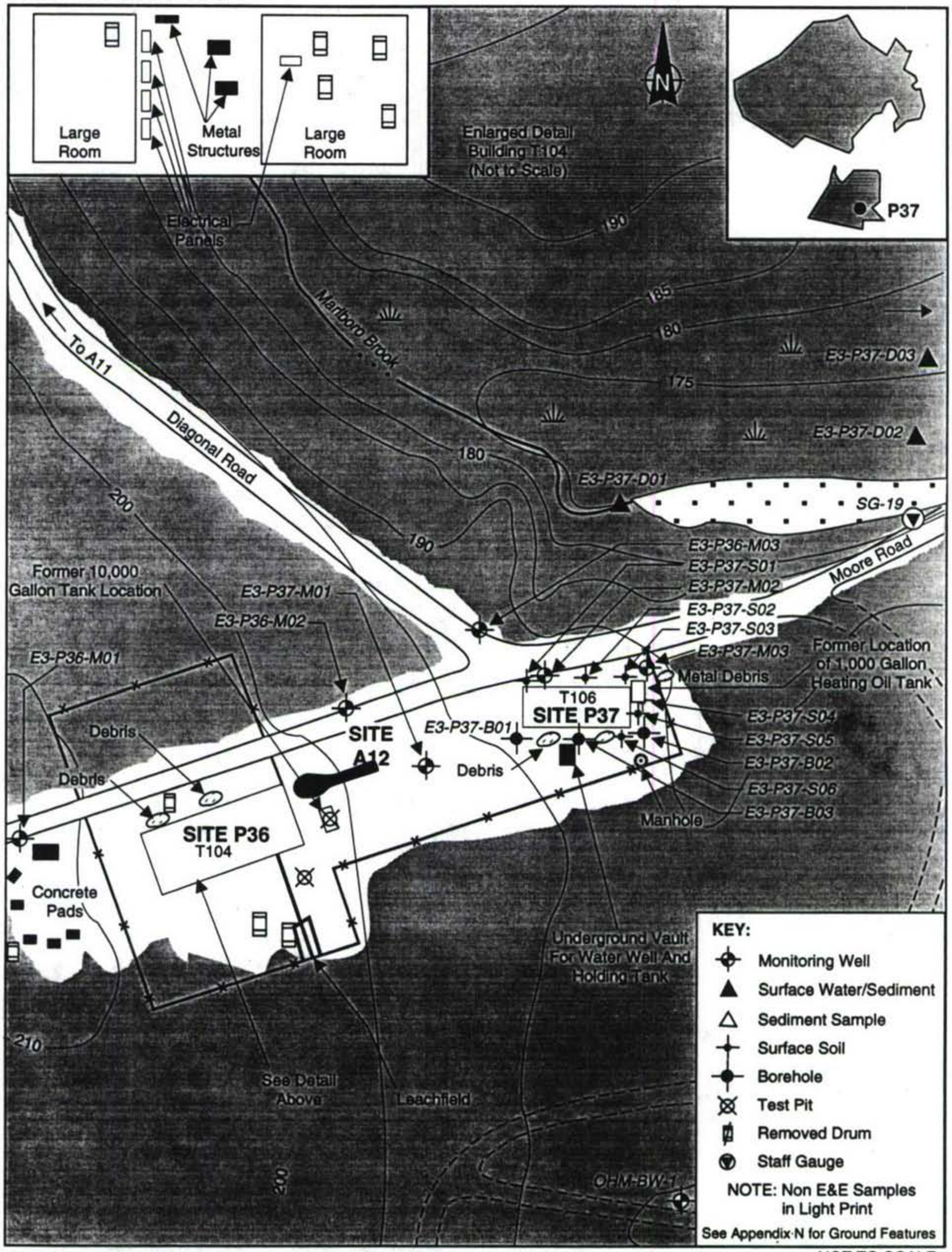
3.2.6.2 Physical Characteristics

Site P37 is on the eastern side of a low hill of glacial till covered by outwash sand and gravel. The hill has been identified as a ground moraine by Hansen (1956), and described as a drumlin by Perlmutter (1962). Surface elevations in the area range from 189 to 194 feet AMSL. Average groundwater elevations beneath the site range from 173 to 182 feet AMSL.

E & E installed three monitoring wells and three borings at Site P37 in 1993. Boreholes at all six locations encountered from 14 to 21 feet of outwash material consisting of poorly sorted sand silt and gravel, underlain by tight till made up of dense silt and clay with some large gravels. The deepest boring (E3-P37-M03) achieved a total depth of 21 feet. Soil samples collected from the 14 to 16 foot intervals at borings E3-P37-M01, E3-P37-M02, and E3-P37-M03 were submitted for grain size and Atterberg limits analyses. All samples were identified as non-plastic mixtures of sand and silt. Additional grain size and Atterberg limits analyses were performed on a surface soil sample (E3-P37-S03) and three sediment samples (E3-P37-D01, E3-P37-D02, and E3-P37-D03) collected at Site P37. The surface soil sample was identified as non-plastic, silty sand. Sediment samples E3-P37-D01 and E3-P37-D03 were also both identified as non-plastic, silty sand; however, sample point E3-P37-D02 was identified as non-plastic poorly graded sand with gravel. Appendix D provides complete geotechnical laboratory reports.

In 1991, a background well (OHM-BW1) was installed by OHM Corporation, approximately 300 feet south of Site P37. Drill logs from the OHM-BW1 indicate that outwash material extended through the entire 25 foot length of the boring. Bedrock was not encountered during any subsurface explorations at the site; however, seismic survey interpretation (Perlmutter 1962), finds that bedrock slopes down to the east and ranges in depth from 60 to 80 feet BGS. Bedrock material is projected to be quartz diorite (Hansen 1956). A seismic survey conducted by E & E at Sites P36 and P37 indicates that bedrock beneath these sites slopes west to east and that bedrock elevations range from 170 to 130 feet AMSL.

11: SUDBURY\UC6_P36.CDR (P2)



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-7 MAP OF SITE P37 BUILDING T106 UST

In 1992, OHM performed a slug test on monitoring well OHM-BW1. A transmissivity of 70 $feet^2$ per day was calculated based on an estimated average aquifer thickness of 65 feet. This transmissivity is comparable to transmissivities calculated for boreholes at wells E3-P37-M01, E3-P37-M02, and E3-P37-M03 from slug test data collected by E & E in 1993. Approximately half of each screened interval at wells E3-P37-M01 and E3-P37-M02 was set in till. These wells yielded transmissivities of 83.82 $feet^2$ per day and 5.17 $feet^2$ per day, respectively. Monitoring well E3-P37-M03 was installed entirely in outwash material. A transmissivity of 116.61 $feet^2$ per day was calculated at this location. All transmissivities measured by E & E were calculated as follows:

$$T = Kb$$

where

T = Transmissivity ($feet^2$ per day)
K = Hydraulic conductivity (foot per day)
b = Aquifer thickness (feet)

Well	K	b	T
E3-P37-M01	11.65	7.19	83.82
E3-P37-M02	1.142	4.53	5.17
E3-P37-M03	23.85	4.89	116.61

For all E & E wells, aquifer thickness was presumed to be equal to the length of the water column in the well. This conservative estimate of aquifer thickness may lead to an underestimation of aquifer transmissivity. Complete slug test data and interpretation can be found in Appendix G.

Surface water flows northeast from Site P37 into Marlboro Brook. Water levels and hydrogeologic data collected at the site indicate that groundwater flows radially from the crest of the glacial hill. Flow across the site follows topography northeast, emptying into Marlboro Brook, which is in turn drained by Hop Brook. Groundwater at OHM-BW1 probably flows southeast, emptying directly into Hop Brook.

Site P37 is located immediately east of Sites A12 and P36, and is identical in geology and hydrogeology. Refer to Sections 3.2.3.2 and 3.2.5.2 for additional geological and hydrogeological information.

3.2.6.3 Ecological Characterization

Site P37 is located in the southern part of the Annex, adjacent to Sites A12 and P36. The ecological survey at these three sites, was conducted simultaneously and is accordingly

discussed in one section. Refer to Section 3.2.5.3 for the discussion of ecological characteristics at the site.

3.2.6.4 Site History

Building T106 has been known as S106 and S6 at other times in its history. This report will refer to it as Building T106. The building was constructed in April 1958 for use by Raytheon, Inc., to use for assembly of electronic equipment, and was referred to as the "Antenna Assembly Building" on a 1962 map of the Annex.

A 1971 Building Information Schedule of Natick Laboratories referred to Building T106 as "laboratory — general purpose" and noted that such use was continuing. The building was designated thus for the remainder of its use up to 1982. At some point in the 1970s, the building was used by the Air Drop Engineering Laboratory (ADEL) of Natick Laboratories for parachute development. The parachute prototype shop was relocated in 1980 to the Natick Center Laboratories to conserve energy and avoid incidents of vandalism that had occurred at the site.

A 1,000 gallon UST for No. 2 Fuel Oil was attached to Building T106. In late 1988, the tank was removed. The tank was in poor condition, with extensive pitting and surficial corrosion, including a 1-inch hole in the bottom of the tank. During subsequent remedial efforts, 16 cubic yards of contaminated soil were removed from the area surrounding tank excavation (Environmental Applications, Inc. (EA) 1989).

3.2.6.5 Results of Previous Investigations

A summary of the activities conducted at Sites P37 through 1992 was included in Section 7.46 of the January 1994 *Final Site/Remedial Investigation Report* (OHM 1994).

Previous activities at the site have consisted of a site reconnaissance, installation of a site boundary well, and groundwater sampling.

The enhanced area reconnaissance performed by OHM in 1992 located scrap metal and an open manhole on the south side of the building. The manhole was found to lead to an underground vault housing the water supply and holding tank formerly used by the nearby Buildings T104 and T106.

A boundary well, OHM-BW1, was installed southeast of Site P37 in October 1991, and sampled in June and October 1992. Subsequent analyses of the 1992 samplings revealed lead (3.04 μg/L and 1.79 μg/L, respectively). Lead was not found in October 1991 samples.

Removals

In December 1988, a 1,000 gallon UST used to store No. 2 Fuel Oil was removed from the northeastern corner of the building by EA. Prior to the excavation, 75 gallons of waste material were removed from the tank. The UST was reported to be in poor condition,

with extensive corrosion and a 1-inch hole located in the side of the tank directly below the fill line. The soil surrounding the tank prior to removal was stained and emanated strong petroleum odors. Sixteen cubic yards of soil were removed from the tank pull area (EA 1989).

Excavation of contaminated soil ceased at the foundation of the building to avoid endangering its structural stability. Soil samples were taken from the bottom of the excavation and from the soil stockpile. Laboratory analytical results indicated concentrations of TPHC (6,521 ppm) for the excavation and TPHC (6,517 ppm) for the stockpile samples. The pit was backfilled with acceptable soil in December 1988. The stockpiled soil was transported to the Consolidated Wastes Services, Inc., landfill in Norridgewock, Maine, in March 1989 for disposal (EA 1989).

3.2.6.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and TPHC. Surface soil samples, subsurface soil samples, and sediment samples were sent for TOC and grain size analysis. In addition, one sediment sample was analyzed for organophosphates. A summary of Phase II Sampling Activities at Site P37 is provided as Table 3-33.

Groundwater Sampling

To characterize groundwater quality and the potential for contaminant migration, E & E installed, developed, and sampled three shallow overburden monitoring wells in the vicinity of building T106 (Site P37). Placement of the three wells was based on the results of the seismic survey performed during the summer of 1993. All three wells were sampled during both groundwater sampling events in September and December 1993.

Well E3-P37-M01 is located southwest of Building T106, in the center of the clearing between Buildings T104 and T106. The monitoring well was screened across the water table at an interval of 9.5 to 19.5 feet BGS. The well is located so that contamination in the groundwater pathway can be monitored from two potential sources: (1) Sites P36 and A12, from which groundwater migrates in a northeasterly direction, and (2) the clearing between the two buildings, where groundwater may have been affected by past activities there.

Well E3-P37-M02 is located along Moore Road near the northwestern corner of Building T106. The well was screened across the water table at an interval 9 to 19 feet BGS. The proximity of the well to Building T106 allows close monitoring of any contaminant plume that may have resulted from past activities in Building T106 or in the clearing west of the building. Because of the well's proximity to Marlboro Brook, it enables investigation of the potential for off-site contaminant migration and characterization of groundwater quality before the groundwater discharges to the wetland area north of the site.

Table 3-33

PHASE II SAMPLING EFFORT FOR SITE P37 — BUILDING T106 UST

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	6	09/01/93 09/02/93 12/01/93	Samples were collected to characterize groundwater quality and assess the potential for contaminant migration in the groundwater pathway.
Subsurface Soils	6 from borings.	08/06/93 08/09/93 08/16/93 12/01/93	Samples were collected to assess subsurface contamination.
Subsurface Soils	3 from wells	08/06/93 08/07/93	Geotechnical samples were collected to characterize nature of subsurface soils and their impact upon the groundwater pathway.
Subsurface Soils	3 from wells.	08/06/93 08/07/93 08/09/93	Samples were collected and sent for TOC analysis to characterize nature of subsurface soils and their impact upon the groundwater.
Surface Soils	6	08/25/93	Samples were collected to investigate surface soil contamination from areas surrounding Building T106.
	6	08/25/93	Samples were collected and sent for TOC analysis to characterize nature of surface soils at the site and their impact upon surface drainage.
	1	08/25/93	A geotechnical sample was collected to characterize the nature of soils.
Surface Water	3	09/16/93 09/23/93	Surface water and sediment samples were collected to characterize water quality and investigate the potential for off-site contaminant migration through the surface water pathway.
Sediment	3	09/16/93 09/23/93	See Surface Water Sampling Rationale.
	2	09/16/93	Samples were collected for TOC analysis.
	3	09/16/93 09/23/93	Geotechnical samples were collected to characterize the nature of soils.

Source: Ecology and Environment, Inc. 1994.

Well E3–P37–M03 is located near the northeastern corner of Building T106, between the edge of the building and Moore Road. The monitoring well was screened across the water table at an interval 10 to 20 feet BGS. The well's location allows monitoring of the groundwater pathway and any potential contaminant plumes migrating along the eastern edge of Sites P36, A12, and P37. The location also enables characterization of groundwater quality before the groundwater discharges to the wetland area north of the site.

Subsurface Soil Sampling

Six samples were collected, two from each of three borings located near Site P37. The samples were collected from two different depths in each boring. The samples provide data to investigate subsurface contamination and characterize the nature of subsurface soils in

the area. Boring E3-P37-B01 was completed in the cleared area southwest of Building T106. Samples were collected from split-spoons at depths between 9 to 11 feet BGS and 14 to 16 feet BGS. Boring E3-P37-B02 was completed near the southeastern corner of Building T106 and sampled using split-spoons at depths between 9 to 11 feet BGS and 14 to 16 feet BGS. The boring allowed investigation of the presence of any residual contamination in the subsurface soils due to past activities in the cleared area south of Building T106. The third boring, E3-P37-B03 was completed in the center of the southern edge of Building T106 and sampled at depths between nine to 11 feet BGS and 14 to 16 feet BGS. The boring, like E3-P37-B02, allowed investigation of the presence of any residual contamination in the subsurface soils due to past activities in the cleared area south of Building T106.

During subsurface soil sampling, geotechnical samples were collected from the saturated zone in each monitoring well and sent for grain size analysis. This Nermin physical analysis provides data on the types of subsurface soils in the region and their impact upon the groundwater pathway. In addition, during monitoring well installation, a sample was collected from the screened interval in each well and sent for TOC analysis. The samples yield further data on the subsurface soils at the site, which aids in assessing the potential for contaminant migration in the groundwater pathway.

As a result of the QA/QC protocols approved in the QAPjP, E & E recollected samples from boring E3-P37-B02 in December 1993 at depths between 9 to 11 feet BGS and 14 to 16 feet BGS and analyzed them for BNAs only.

Surface Soil Sampling

Six samples were collected from areas surrounding Building T106 to investigate whether there was surface contamination due to past activities at the site. The samples were collected from areas that had obvious discoloration or stressed vegetation or were situated in surface drainage channels. At each of the six locations, an additional sample, E3-P37-S03, was collected and sent for TOC analysis. The samples will help in characterizing the nature of the surface soils in the area and assessing the possibility that the soils are future sources of contamination.

Surface Water and Sediment Sampling

Three locations were sampled to characterize the water quality of Marlboro Brook as it leaves Annex property. Sediment samples were analyzed for TOC and grain size (all samples), as well as Atterberg limits (only E3-P37-D03). Furthermore, sediment sample E3-P37-D03 was analyzed for organophosphate concentration. The sample data also provides information to assess the potential for off-site contaminant migration through the surface water pathway. The locations were chosen downgradient of surface runoff areas for Sites A12, P36, or P37. The location of sediment sample E3-P37-D01 lies on the western edge of the pond and wetland area, which is approximately 100 feet northeast of the intersection of Diagonal Road and Moore Road. The locations of sediment samples E3-P37-D02 and E3-P37-D03 are both further downgradient of the site and further downstream of location E3-P37-D01. Sediment samples E3-P37-D02 and E3-P37-D03 monitor levels of

contamination in the stream and sediments as Marlboro Brook flows east past Sites A12, P36, and P37 before converging with Hop Brook outside Annex property. To further characterize water quality as Marlboro Brook leaves Annex property, sediment sample location E3–P37–D03 was resampled in late September 1993 for explosives, phosphates, herbicides, and organophosphorus pesticides.

3.2.6.7 Nature and Extent of Contamination

The initial concern at Site P37 was that the residual TPHCs detected in soils (up to 6,521 μg/g) at the excavation around the removed UST on the northeast corner of the building may be affecting surrounding media.

Analysis of wells located upgradient (E3-P37-M01) and wells downgradient of the site (E3-P37-M02 and E3-P37-M03) indicated several elevated levels of TPHCs. TPHC (1,290 μg/L, estimated) was detected upgradient at well E3-P37-M01, and the highest downgradient concentration was slightly higher at 1,930 μg/L (estimated) at well E3-P37-M02. TPHC was not detected above the method detection limit of 200 μg/L in the well (E3–P37–M03) located closest to the approximate location of the UST which was removed from this site. The TPHC concentration at well E3-P37-M02 was above the groundwater screening value of 1,000 μg/L (MCP GW-1), but was below the MCP GW-3 value for groundwater not used as drinking water of 5,000 μg/L. No volatile constituents of fuel oil such as benzene, toluene, ethylbenzene, or xylene (BTEX) were detected in any wells at Site P37. Aluminum, iron, and manganese were elevated above screening values in unfiltered samples from both the upgradient and downgradient wells. These metals were also above screening levels in unfiltered samples from the well upgradient of Site P36, likely indicating these detections reflect naturally occurring levels. No metals were detected above screening values in the filtered samples taken at well E3–P37–M01 or well E3–P37–M02. No filtered samples were taken at E3-P37-M03 during the September 1993 sampling round. A summary of detections above preliminary screening levels is provided in Table 3-34. Also, a complete summary of all analytical results for Site P37 is provided in Tables 3-35 through 3-39, following Section 3.2.6.8, Conclusions and Recommendations for Site P37.

Bis(2–ethylhexyl)phthalate (2.50 μg/L) was detected only in well E3-P37-M03, which is below the screening value of 6 μg/L (SDWA MCL), and is likely a field sampling artifact. No pesticides were positively detected in the Site P37 monitoring wells.

Three subsurface soil borings were conducted in the area immediately south of Building T106. In analysis of samples from the borings, no compounds were detected at levels above soil screening values. Several metals were slightly elevated above background levels. Hexadecanoic acid (0.270 μg/g, maximum) was detected in two samples. No screening value could be found for this compound. TPHC (27.6 μg/g, maximum) was detected at levels above the method detection limit in all three borings, but at levels below the soil screening value of 500 μg/g (MCP GW-1/S-1).

Table 3-34

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P37

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency above screen level
GW (μg/L)	Aluminum(U)[1]	--	50	MA SMCL[3]	45,000	E3-P37-M01	3/3
	Aluminum(F)[2]	--			36.7	E3-P37-M02	0/3
	Lead(U)	--	15	MA MCL	29.8	E3-P37-M03	2/3
	Lead(F)	--			6,54	E3-P37-M01	0/3
	Iron(U)	--	300	MA SMCL	62,000	E3-P37-M03	2/2
	Iron(F)	--			43.7	E3-P37-M02	0/1
	Manganese(U)	--	50	MA SMCL	12,000	E3-P37-M03	3/3
	Manganese(F)	--			52.5	E3-P37-M01	1/3
	TPHC	--	1000	MCP GW-1[4]	1,930 (J)[11]	E3-P37-M02	2/3
SW (μg/L)	Arsenic	3.15	.018	MA/CWA WQC[5]	45.8	E3-P37-D03	3/3
	Iron	4,810	1,000	MA/CWA WQC[6]	14,000	E3-P37-D03	2/3
	Lead	10.3	3.2	MA/CWA WQC[6]	23.2	E3-P37-D01	2/3
	Bis(2-ethylhexyl)phthalate	10	1.8	MA/CWA WQC[6]	24.0	E3-P37-D02	1/3
SED (μg/g)	Arsenic	2.03	30 6	MCP GW-1/S-1[7] Ontario MOE LEL	37.4	E3-P37-D03	1/3 2/3
	Beryllium	0.18	0.4	MCP GW-1/S-1	1.09 (est.)	E3-P37-D03	2/3
	Cadmium	0.357	0.6	Ontario MOE LEL[8]	2.50 (est.)	E3-P37-D03	1/3
	Iron	7590	20000	Ontario MOE LEL	26,500	E3-P37-D03	1/3
	Lead	4.48	31	Ontario MOE LEL	39.2	E3-P37-D03	1/3
	Manganese	70.5	390 460	Reg. III RBC[9] Resid. Ontario MOE LEL	1,680	E3-P37-D03	1/3
	Nickel	5.92	16	Ontario MOE LEL	20.7	E3-P37-D03	1/3

See end of table for footnotes.

Table 3-34 (continued)

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P37

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency above screen level
	γ-Chlordane	--	0.0005	NOAA ERL[10] (for Chlordane)	0.190	E3-P37-D03	1/3
	Endrin	--	0.00002	NOAA ERL	0.024 (est.)	E3-P37-D01	1/3
	Heptachlor Epoxide	--	0.06 0.005	MCP GW-1/S-1 Ontario MOE LEL	0.114	E3-P37-D03	1/3 1/3
	DDE		0.002	NOAA ERL	0.345	E3-P37-D03	2/3
	TPHC	16.6	2	Ontario MOE LEL	174	E3-P37-D03	1/3

[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MCP GW-1 = Massachusetts Contingency Plan Groundwater Category GW-1.
[5]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for consumption of water and fish.
[6]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for aquatic life.
[7]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[8]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[8]Reg III RBC = EPA Region III Risk-Based Concentrations.
[10]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.
[11]Value is estimated.

Source: Ecology and Environment, Inc. 1994.

Analysis of surface soil samples taken on the north and eastern sides of Building T106 had results similar to subsurface soils, with only slightly higher levels of TPHC. No compounds were found in surface soil samples above screening values. Manganese and nickel were the only metals slightly elevated above background soil levels. The only volatile organic detected was methylene chloride (0.012 μg/g, maximum). Bis(2-ethylhexyl)phthalate (0.160 μg/g (estimated) was detected in one sample. TPHC (up to 87.8 μg/g) were found in all six soil samples, in concentrations below the soil screening value of 500 μg/g (MCP GW-1/S-1).

Three surface water and sediment samples were taken on Marlboro Brook to characterize any potential impact of Site P37 (and Sites P36 and A12). It is important to note that all three of these samples are downstream of other sites in Watershed 2, including Site P28 (the Rocket Range/Railroad Classification Yard), and Site A11 (the leach field). While all of the surface water/sediment sample points are downgradient of Sites P36, P37 and A12, for ease of reference, these sample points will be referred to by their relative position in

Marlboro Brook. The first sample (at E3-P37-D01) will be referred to as the upper sample, the second sample (at E3-P37-D02) as the middle sample, and the third sample (E3-P37-D03) as the lower sample.

In analysis of the three surface water samples, arsenic, iron, lead, and bis(2-ethylhexyl)phthalate were detected above screening values. Arsenic concentrations at the upper and middle surface water samples (9.16 μg/L and 2.59 μg/L, respectively) were significantly lower than the arsenic (45.8 μg/L) found at the lower sample, which was taken off-site at the point that Marlboro Brook crosses under Moore Road. Arsenic was also detected further upstream from samples at E3-A11-D01 near Site A11 at an even higher level (440 μg/L). All of the arsenic detections in surface water samples taken in relation to Site P37 were above the MA/CWA WQC for consumption of water and fish (0.018 μg/L) and for consumption of fish only (0.14 μg/L), but well below the WQC for protection of aquatic life (190 μg/L). Iron (up to 14,000 μg/L) and lead (up to 23.2 μg/L) at the upper and lower surface water samples were found at levels above the screening values for iron (1,000 μg/L) and lead (3.2 μg/L) (both MA/CWA WQC for protection of aquatic life). Iron and lead were found at lower levels in the middle sample below screening values. Bis(2-ethylhexyl)phthalate was found in the middle sample at 24.0 μg/L, which is above the screening value of 1.8 μg/L (MA/CWA WQC for protection of aquatic life). This compound was found at a much lower level (1.40 μg/L) in the upper sample, and was not found at the lower sample. No explosive compounds were detected at any of the three sample locations.

Analysis of sediment samples also indicated elevated metals, including arsenic, beryllium, cadmium, iron, lead, manganese, and nickel, and several pesticides, at concentrations above sediment screening values. Arsenic was elevated above background in all three sediment samples in a similar pattern to the detections of arsenic in surface waters. The concentrations in the upper and middle samples (8.72 μg/g and 3.01 μg/g, respectively) were significantly lower than in the lower sample (37.4 μg/L). This pattern may reflect the differences in TOC content of the sediments, which was highest (372,000 μg/g) in the lower sample. The lower sample, where the highest detections of metals in sediments were found, was taken in a wetland area along Moore Road. TOC content was lowest in the middle sample (10,800 μg/g), where metal levels in sediment were the lowest. The arsenic level in the upper and lower sediment samples were above the ecologically-oriented lowest effect level used as a screening value of 6 μg/g (Ontario MOE LEL). The arsenic concentration at the lower sample was also slightly above the NOAA ERL (33 μg/g) but below the NOAA ERM value of 85 μg/L. The arsenic level at the lower sample was also above the human health oriented soil screening value of 30 μg/g (MCP GW-1/S-1).

The pattern of detections for other metals were similar to arsenic, with the lowest values found in the middle sample, higher in the upper sample, and highest in the lower sample where organic carbon content was the highest. Other metals detected above sediment screening values were cadmium, iron, lead, manganese and nickel, which were above ecologically-oriented lowest effects levels used for screening based on Ontario MOE LEL for these compounds (Sitzhka 1991). The cadmium, lead, and nickel levels were well below the NOAA ERM levels. No NOAA ERM values exist for iron or manganese. The beryllium (up to 1.09 μg/g) concentrations and manganese (up to 1,680 μg/g) were also above human health

oriented soil screening values used in this study. The source of these metals is unknown. Given that these metals were not excessively elevated in groundwater, surface soils, or subsurface soils sampled at Sites P36, P37 or A12, it is doubtful that the source of these metals is at these sites. The source may be located upstream or it may be naturally occurring levels in the stream itself.

Two PAHs, fluoranthene and pyrene, were detected in the lower sediment sample but below sediment screening values. Toluene (0.030 μg/g) was found at a trace level in the upper sample but no sediment screening value could be found for the compound. TPHC were detected below the detection limit in the upper and middle sediment samples but were found at 174 μg/g in the lower sample, potentially indicating that the source of the petroleum hydrocarbons may be along Moore Road where the lower sample was taken. Given the distance from the site, and the non-detection of TPHC in the other two samples, this TPHC found in the lower sample is not thought to be related to the TPHC detected in groundwater or soils at the site itself.

Several pesticides were detected in sediment samples in concentrations above sediment screening values. The highest concentrations of pesticides were all found in the lower sample and were significantly elevated over the levels in the other two samples. γ-chlordane (0.190 μg/g), endrin (0.540 μg/g), heptachlor epoxide (0.114 μg/g), and DDE (0.345 μg/g) were found in the lower sample at levels above the ecologically-oriented lowest effect levels used as screening values for sediments (NOAA and Ontario MOE LEL values). These pesticide detections were also compared to NYSDEC and EPA SQC that were adjusted for the TOC content of the lower sample (372,000 or 37.2 percent). The levels of γ-chlordane, endrin, and heptachlor epoxide were also above the TOC-adjusted NYSDEC and EPA criteria (see Table 3-34). The concentration of heptachlor epoxide (0.114 μg/g) was also above the human health oriented soil screening values of 0.06 μg/g in MCP GW-1/S-1.

3.2.6.8 Conclusions and Recommendations

A remedial investigation is currently underway for Sites P36, A12, and P37, which have been combined for the RI due to their proximity. Conclusions and recommendations for Site P37 will be made following the completion of the RI.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-35
Chemical Summary Report For Groundwater
Site: P37
Units: UGL

	Site ID	E3-P37-M01	E3-P37-M01	E3-P37-M01	E3-P37-M01	E3-P37-M01	E3-P37-M01
	Field Sample ID	MDP37011	MFP37011	MFP37012	MHP37011	MXP37011	MXP37012
	Sample Date	09/02/93	09/02/93	12/01/93	09/02/93	09/02/93	12/01/93
Test	Parameter .						
TAL METAL	Aluminum	12000 @	15.5 BJ	22.7 BJ	20.8 BJ	11000 @	45000 @
	Antimony	1.81 J	< 5.00	4.53 BJ	< 5.00	2.70 J	< 5.00
	Arsenic	34.5	< 2.00	2.14	< 2.00	29.2	29.4
	Barium	62.1	8.49 J	7.33 J	6.09 J	74.8	232
	Beryllium	0.475 J	< 5.00	< 5.00	< 5.00	0.547 J	1.76 J
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00	1.35 J	< 5.00
	Calcium	4960	4070	4740	4060	4990	10800
	Chromium	16.3	< 10.0	< 10.0	< 10.0	19.1	54.0
	Cobalt	18.4	< 10.0	< 10.0	< 10.0	16.1	29.9
	Copper	160	< 10.0	< 10.0	< 10.0	14.2	108
	Iron	1500 K@	< 25.0	30.0 B	< 25.0	14000 K@	55000 @
	Lead	6.54	< 5.00	< 5.00	< 5.00	5.38	19.9 @
	Magnesium	3580	658	1220	720	3450	12300
	Manganese	408 @	24.4	52.5 @	24.1	389 @	624 @
	Nickel	< 10.0	< 10.0	< 10.0	< 10.0	17.3	58.5
	Potassium	2610	647 J	1190 B	726 J	2520	8960 K
	Sodium	4100	3780	8890 K	3810	4140	11200 K
	Vanadium	22.3	< 10.0	< 10.0	< 10.0	21.1	81.1
	Zinc	113 K	65.7 B	6.03 BJ	78.5 B	144	98.1
TCL BNA	Bis(2-ethylhexyl)phthalate	< 10.0				< 10.0	< 10.0
TPHC	Total Petroleum Hydrocarbons	< 2000				< 2000	1290 KJ@

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-35
Chemical Summary Report For Groundwater
Site: P37
Units: UGL

Test	Parameter	E3-P37-M02 / MFP37021 / 09/01/93	E3-P37-M02 / MFP37022 / 12/01/93	E3-P37-M02 / MXP37021 / 09/02/93	E3-P37-M02 / MXP37022 / 12/01/93	E3-P37-M03 / MFP37031 / 09/01/93	E3-P37-M03 / MFP37032 / 12/01/93
TAL METAL	Aluminum	36.7 B	22.0 BJ	7790 @	4190 @	< 25.0	20.6 BJ
	Antimony	3.21 BJ	< 5.00	1.85 J	< 5.00	6.32 B@	6.79 B@
	Arsenic	< 2.00	< 2.00	5.84	3.68	< 2.00	0.840 J
	Barium	10.2	< 10.0	60.3	30.9	4.80 J	8.16 J
	Beryllium	< 5.00	< 5.00	0.349 J	< 5.00	< 5.00	< 5.00
	Cadmium	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
	Calcium	6980	5180	8920	6310	3650	4310
	Chromium	< 10.0	< 10.0	13.3	9.76 J	< 10.0	< 10.0
	Cobalt	< 10.0	< 10.0	7.62 J	5.00 J	< 10.0	< 10.0
	Copper	< 10.0	4.32 J	10.8	8.02 J	< 10.0	< 10.0
	Iron	43.7 B	11.5 BJ	9280 K@	4480 @	< 25.0	34.6 B
	Lead	< 5.00	< 5.00	< 5.00	2.07 BJ	< 5.00	< 5.00
	Magnesium	1180	828	3510	1890	574	682
	Manganese	42.7	9.84 B	186 @	79.8 @	20.1	4.48 BJ
	Nickel	< 10.0	< 10.0	12.0	11.7	< 10.0	< 10.0
	Potassium	1060	1120 B	2770	1860 B	662 J	1600 B
	Sodium	3970	5480 B	4580	5590 B	3330	5000 B
	Vanadium	4.73 J	< 10.0	15.6	5.20 J	< 10.0	< 10.0
	Zinc	17.2 BJ	11.0 BJ	81.1 K	30.4 K	108 B	71.9
TCL BNA	Bis(2-ethylhexyl)phthalate			< 10.0	< 10.0		
TPHC	Total Petroleum Hydrocarbons			< 2000	1930 KJ@		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-35
Chemical Summary Report For Groundwater
Site: P37
Units: UGL

Test	Parameter	E3-P37-M03	E3-P37-M03
	Field Sample ID	MXP37031	MXP37032
	Sample Date	09/01/93	12/01/93
TAL METAL	Aluminum	16000 @	44000 @
	Antimony	2.24 J	< 5.00
	Arsenic	39.8	100 @
	Barium	84.0	176
	Beryllium	0.980 KJ	2.09 J
	Cadmium	< 5.00	< 5.00
	Calcium	5360	9600
	Chromium	28.0	67.2
	Cobalt	23.6	47.6
	Copper	22.6	65.8
	Iron	20000 @	62000 @
	Lead	9.66	29.8 @
	Magnesium	4910	12400
	Manganese	506 @	1200 @
	Nickel	28.5	61.9
	Potassium	4040	9170
	Sodium	4580	6140 K
	Vanadium	31.4	81.1
	Zinc	158	282
TCL BNA	Bis(2-ethylhexyl)phthalate	2.50 J	< 10.0
TPHC	Total Petroleum Hydrocarbons	< 2000	< 2000

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low. K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-36
Chemical Summary Report For Subsurface Soils
Site: P37
Units: UGG

Test	Parameter	Site ID / Field Sample ID / Sample Date / Depth	E3-P37-B01	E3-P37-B01	E3-P37-B02	E3-P37-B02	E3-P37-B03	E3-P37-B03
		Field Sample ID	BX370101	BX370102	BX370201	BX370202	BD370302	BX370301
		Sample Date	08/09/93	08/09/93	08/06/93	08/06/93	08/16/93	08/16/93
		Depth	9.0 ft.	14.0 ft.	9.0 ft.	14.0 ft.	14.0 ft.	4.0 ft.
TAL METAL	Aluminum		5000	4300	3700	3900	6940	5230
	Arsenic		4.58 J	4.04 J	4.71 J	5.59 J	5.47 J	6.45 J
	Barium		21.1	23.2	17.2	17.5	35.5 !	16.0
	Beryllium		0.243 J	0.252 J	0.189 J	0.202 J	0.306 J	0.245 J
	Cadmium		0.471 J	0.407 J	0.336 J	0.376 J	< 0.500	< 0.500
	Calcium		457 J	1340 !	933	1030	1190 !	651
	Chromium		11.4 K	11.1 K	8.14 K	8.20 K	16.0 !	9.74
	Cobalt		6.09	6.31 !	4.14	3.82	8.02 !	4.92
	Copper		8.75	9.34	5.92	5.21	9.56	7.86
	Iron		8800	8100	6500	6700	12000	8990
	Lead		4.13 B	3.51 B	23.0	2.68 B	2.99 B	3.55 B
	Magnesium		1970	1640	1450	1440	2730 !	2000
	Manganese		110 !	129 !	76.7	69.4	151 !	95.9 !
	Nickel		11.3 !	14.0 !	6.30	6.59	21.8 !	10.3
	Potassium		1120 !	1090 !	832 !	884 !	1530 !	1080 !
	Vanadium		11.1	11.7	8.82	8.52	16.7	11.6
	Zinc		24.1 K	31.3	13.7 K	15.1 K	41.7	28.4
TCL BNA	Di-n-octyl phthalate		< 0.330	< 0.330	< 0.330 R	< 0.330 R	0.028 J	< 0.330
	Hexadecanoic Acid					0.270		
TOC	Total Organic Carbon		6620	5700			2070 J	3940
TPHC	Total Petroleum Hydrocarbons		19.7 J	27.6	17.7 J	17.5 J	< 20.0	12.9 J

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-36
Chemical Summary Report For Subsurface Soils
Site: P37
Units: UGG

Test	Parameter	E3-P37-B03	E3-P37-B04	E3-P37-B04	E3-P37-M01	E3-P37-M02	E3-P37-M03
	Field Sample ID	BX370302	BXP37041	BXP37042	BX3701X1	BX3702X1	BX3703X1
	Sample Date	08/16/93	12/01/93	12/01/93	08/06/93	08/07/93	08/09/93
	Depth	14.0 ft.	0.0 ft.	0.0 ft.	14.0 ft.	14.0 ft.	14.0 ft.
TAL METAL	Aluminum	6620					
	Arsenic	6.98 J					
	Barium	27.6 !					
	Beryllium	0.327 J					
	Cadmium	< 0.500					
	Calcium	975					
	Chromium	13.6					
	Cobalt	6.74 !					
	Copper	8.70					
	Iron	11500					
	Lead	3.77 B					
	Magnesium	2550 !					
	Manganese	129 !					
	Nickel	17.7 !					
	Potassium	1460 !					
	Vanadium	15.0					
	Zinc	35.6					
TCL BNA	Di-n-octyl phthalate	< 0.330	< 0.330	< 0.330			
	Hexadecanoic Acid	0.120					
TOC	Total Organic Carbon	3770 J			13300	6490	11900
TPHC	Total Petroleum Hydrocarbons	13.2 J					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value. L= Result bias low. K= Result bias high. R= Result rejected.
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@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-37
Chemical Summary Report For Surficial Soils
Site: P37
Units: UGG

	Site ID	E3-P37-S01	E3-P37-S02	E3-P37-S03	E3-P37-S04	E3-P37-S05	E3-P37-S06
	Field Sample ID	SX3701X1	SX3702X1	SX3703X1	SX3704X1	SX3705X1	SX3706X1
	Sample Date	08/25/93	08/25/93	08/25/93	08/25/93	08/25/93	08/25/93
Test	Parameter .						
TAL METAL	Aluminum	8700	8300	8890	7710	6270	5390
	Arsenic	5.52	7.09	7.35	5.94	6.54	5.80
	Barium	15.6	13.3	12.8	13.2	12.4	9.62
	Beryllium	0.312 J	0.277 J	0.282 J	0.269 J	0.236 J	0.147 J
	Calcium	< 500	< 500	< 500	359 J	342 J	< 500
	Chromium	13.2	11.6	17.1 !	11.9	9.53	9.34
	Cobalt	6.04 K	5.51 K	5.81 K	5.36 K	4.99 K	4.84 K
	Copper	9.85	7.91	7.74	9.46	6.82	7.34
	Iron	10000	9000	10100	9890	7480	8360
	Lead	18.0	18.0	18.0	20.0	7.73	17.0
	Magnesium	1900	1620	1920	1700	1540	1590
	Manganese	167 !	105 !	123 !	122 !	110 !	122 !
	Nickel	12.5 !	10.8 !	13.3 !	10.4	9.02	9.82
	Potassium	516 K	433 K	442 K	551 K	526 K	491 K
	Vanadium	15.8	14.3	16.3	14.7	10.6	11.5
	Zinc	130 K!	72.1 K!	93.4 K!	130 K!	23.1 K	62.5 K!
TCL BNA	Bis(2-ethylhexyl)phthalate	0.150 J	< 0.330	0.046 J	1.30	< 0.330 L	0.160 JL
TCL Pest	Endosulfan,B	0.001 JU	< 0.002	< 0.002	0.002 C	< 0.002	< 0.002
	P,P-DDD	0.041 C	0.052 C	0.021 C	0.015 C	0.004 C	0.021 C
	P,P-DDE	0.057 C	0.057 C	0.010 C	0.006 C	0.001 JU	0.017 C
	P,P-DDT	0.140 C	0.160 C	0.072 C	0.063 C	0.021 C	0.081 C
TOC	Total Organic Carbon	12000	24100	14100	17000	12300	8560
TPHC	Total Petroleum Hydrocarbons	58.0	55.8	97.8	34.1	86.0	27.5

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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L= Result bias low.
R= Result rejected.
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@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 3-38
Chemical Summary Report For Surface Waters
Site: P37
Units: UGL

	Site ID	E3-P37-D01	E3-P37-D02	E3-P37-D03	E3-P37-D03		
	Field Sample ID	WXP37011	WXP37021	WXP37031	WXP37031		
	Sample Date	09/16/93	09/16/93	09/16/93	09/23/93		
Test	Parameter .						
TAL METAL	Aluminum	7060 !	156	1480 !			
	Arsenic	9.16 !@	2.59 @	45.8 !@			
	Barium	52.2 J!	7.70 J	34.7 J!			
	Beryllium	1.39 J	< 5.00	< 5.00			
	Calcium	7050 J	2260 J	3880 J			
	Chromium	8.52 JK!	< 10.0 K	< 10.0 K			
	Cobalt	7.51 J!	< 10.0	10.2 !			
	Copper	6.27 J	< 10.0	3.76 J			
	Iron	6490 !#	903	14000 !#			
	Lead	23.2 !#	< 5.00	11.4 !#			
	Magnesium	1390	658	934			
	Manganese	192 J!	124 J	1700 J!			
	Nickel	< 10.0	< 10.0	10.6 !			
	Potassium	1060	319 J	904 J			
	Sodium	4660	2880	4700			
	Vanadium	9.51 J!	< 10.0	6.05 J!			
	Zinc	46.5 !	20.4 !	28.9 !			
TCL BNA	Bis(2-ethylhexyl)phthalate	1.40 J	24.0 @	< 10.0			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
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@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 3-39
Chemical Summary Report For Sediments
Site: P37
Units: UGG

Test	Site ID	E3-P37-D01	E3-P37-D02	E3-P37-D03	E3-P37-D03		
	Field Sample ID	DXP37011	DXP37021	DXP37031	DXP37031		
	Sample Date	09/16/93	09/16/93	09/16/93	09/23/93		
Test	Parameter .						
TAL METAL	Aluminum	3910	4870	4630			
	Antimony	< 0.500 L	< 0.500	1.72 JL!			
	Arsenic	8.72 !#	3.01 !	37.4 !@#			
	Barium	23.1 J	17.1	72.9 !			
	Beryllium	0.734 JL!@	0.217 JL!	1.09 JL!@			
	Cadmium	0.744 BJ#	0.576 BJ	2.50 KJ!#			
	Calcium	3170 !	306 J	4650 !			
	Chromium	5.91 J	10.1 !	7.81 J			
	Cobalt	3.56 J	4.71 !	25.3 !			
	Copper	7.39 L!	4.25 L	15.4 L!			
	Iron	5070	8730 !	26500 !#			
	Lead	20.3 !	3.22	39.2 !#			
	Magnesium	362 J	203000 !	832 J			
	Manganese	203 !	115 !	1680 !@#			
	Nickel	6.50 !	9.23 !	20.7 !#			
	Potassium	< 20000	888	373 KJ			
	Selenium	0.852 JL!	< 0.200	< 0.200 L			
	Thallium	< 0.500	0.093 J	< 0.500			
	Vanadium	6.50 J	11.4	21.8 !			
	Zinc	42.1 JL!	32.6 J!	72.9 J!			
TCL BNA	Fluoranthene	< 0.330	< 0.330	0.290 J			
	Pyrene	< 0.330	< 0.330	0.310 J			
TCL Pest	Endosulfan,B	< 0.002	0.001 JC	< 0.002			
	Endrin	0.024 JC#	0.005 KU#	0.540 JU#			
	Heptachlor Epoxide	0.004 JU!	< 0.002	0.114 C!@#			
	P,P-DDE	0.097 C#	0.007 U#	0.345 C#			
	alpha-BHC	< 0.002	< 0.002	0.027 C!			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 3-39
Chemical Summary Report For Sediments
Site: P37
Units: UGG

	Site ID	E3-P37-D01	E3-P37-D02	E3-P37-D03	E3-P37-D03		
	Field Sample ID	DXP37011	DXP37021	DXP37031	DXP37031		
	Sample Date	09/16/93	09/16/93	09/16/93	09/23/93		
Test	Parameter .						
TCL Pest	gamma-Chlordane	0.005 JU!#	0.002 JU#	0.190 C!#			
TCL VOA	Toluene	0.030	< 0.005	< 0.005			
TOC	Total Organic Carbon	254000	10800	372000			
TPHC	Total Petroleum Hydrocarbons	< 20.0	< 20.0	174 !#			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

3.2.7 Site P38 — Former Railroad Inspection Pit

Site P38 was identified by OHM in a site reconnaissance in 1991 during which OHM found a concrete foundation along the old railroad classification yard. A site map is presented in Figure 3-8.

3.2.7.1 Site Location

Site P38 encompasses a small area at the southern end of the Rocket Range/Railroad Classification Yard (Site P28) on the southern part of the Annex. A pit has been excavated on the eastern side of the railroad bed north of the area. About 150 feet south of the pit on the western side of the track, there is a half-buried concrete foundation in the shape of a "T." This concrete structure is believed to have been part of a railroad inspection pit. Behind the T-shaped foundation and within the treeline, lies a fallen electrical post and a 15-foot, rusted metal pipe.

3.2.7.2 Physical Characteristics

Site P38 is on a broad, flat area of glacial outwash sand and gravel immediately south of Site P28. The surface elevation at the site is approximately 195 feet AMSL. No wells were installed at the area, but groundwater was observed at 6.5 feet BGS during subsurface exploration.

E & E completed three boreholes at the site in 1993. Borehole E3-P38-B01 reached a depth of 11 feet and boreholes E3-P38-B02 and E3-P38-B03 reached depths of only five feet each. All borings encountered outwash material consisting of a sand, silt and gravel mixture over their entire length. A surface soil sample (E3-P38-S01) collected at Site P38 was submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as non-plastic, well-graded sand with silt. Please refer to Appendix D for complete geotechnical laboratory reports.

As part of a groundwater study of the Maynard Area, a test boring (S112) was completed in 1955 (Perlmutter 1962) to a depth of 84 feet approximately 150 feet east of Site P38. This boring encountered glacial outwash deposits of sand and gravel extending from the surface to 25 feet BGS. A layer of glacial till was observed from 25 to 64 feet BGS. Bedrock, identified as the Marlboro Formation, was reached at 64 feet BGS (Perlmutter 1962). In seismic survey through the classification yard, bedrock west of the area was estimated to be approximately 55 feet BGS.

Surface water at Site P38 may flow west to an adjacent wetland area with no outlet. No wells were installed at Site P38; however, topography, drainage, and Perlmutter's study of the area, indicate that groundwater flow is possibly south toward Hop Brook (Perlmutter 1962), but Marlboro Brook to the east is also a potential discharge point.

The flat terrain and well drained soils suggest that runoff is unusual except during snowmelt when the ground is frozen or during exceptional storms.

3.2.7.3 Ecological Characterization

The site lies within an area vegetated with grasses and forbs. Surrounding this area is an immature stand of cherry and hardwood trees. Approximately 100 feet south of the site, the vegetation changes to a dense, mixed oak forest with trees ranging from 41 to 60 feet in height (LFS 1983).

Generally, groundwater will flow east towards Marlboro Brook and a nearby wetland (E & E 1993). Flow south to Hop Brook is also a possibility. The nearby wetland, seasonally saturated and vegetated with deciduous trees, is approximately 200 feet east of the site. Immediately to the west is a second wetland, which may also receive surface water runoff from the site. This wetland is also seasonally saturated and vegetated with deciduous trees and shrubs (USDOI 1977).

This area contains three different habitat types: grassland, mixed oak forest, and forested wetland. The forest edge around the site supports a community of birds and mammals that depend on both forested and open areas: nesting songbirds, mice, deer, and raptors all occur in edge habitats. Mixed oak forests are of great importance to wildlife: Waterfowl, upland gamebirds, songbirds, small mammals, and deer rely heavily on acorns for food (Martin *et al.* 1951). In addition, the tannin-rich, slowly-decaying leaves of oaks provide a thick mat for reptiles and amphibians to find food in or use as shelter. Trees, particularly the evergreen ones, also serve as cover. In addition, forested wetlands attract an array of aquatic and upland species, as well as species specifically adapted to wetlands.

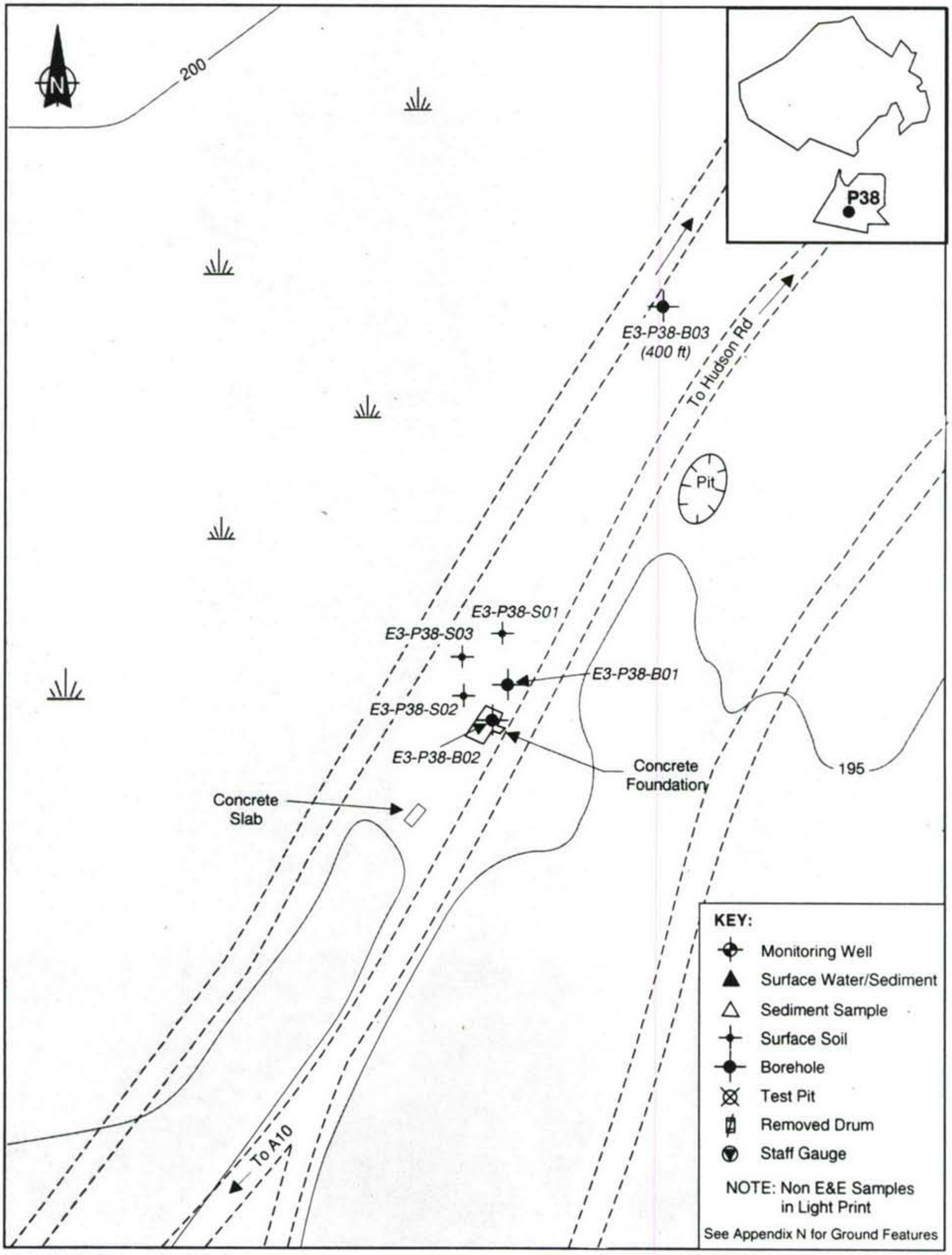
No sightings of rare, threatened, or endangered species on or in the general vicinity of the site have been documented. Nor are any unique habitats known to occur near the site (NHESP 1992).

3.2.7.4 Site History

Site P38 is the suspected location of a railroad inspection pit at the southern end of the railroad classification yard. The 1942 facility map identifies an inspection pit in an area south of the classification yard, but north of the intersection of two rail lines leading into the yard. The 1944 facility map describes the pit as a rectangular structure straddling two lines of track at the entrance to the classification yard. The pit is situated perpendicular to the tracks, with a small protrusion pointing to the west of the tracks. A map from 1946 notes that the inspection pit is in the area where the classification yard begins to branch out. On facility maps from 1955 and 1962, this structure is not noted. However, an electrical line appears to cross the rail lines in the same location identified for the pit on the 1944 map. The railway lines were removed in 1967, and it is likely that the structure was demolished at the same time.

As stated previously, in 1991, OHM found, in the approximate location indicated by the 1944 map, a concrete foundation that had been filled with soil. The structure may have

11: SUDBURY\UC6_P38.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-8 MAP OF SITE P38
FORMER RAILROAD INSPECTION PIT

been used for inspection of railway cars that passed into the classification yard. The structure may also have been used for maintenance.

3.2.7.5 Results of Previous Investigations

As stated, OHM performed an Enhanced Area Reconnaissance in 1991 at the site, but found no evidence of contamination and did not take samples from around the concrete foundation.

3.2.7.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and TPHC. In addition, surface soil samples were analyzed for TOC and one was sent for geotechnical analysis to determine grain size. A summary of Phase II Sampling Activities at Site P38 is provided as Table 3-40.

Table 3-40

PHASE II SAMPLING EFFORTS FOR SITE P38 — FORMER RAILROAD INSPECTION PIT

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Subsurface Soils	6	08/10/93 09/24/93 12/01/93	Samples were collected to characterize the nature of subsurface soils and investigate contamination in subsurface soils due to past site activities.
Surface Soils	3	08/25/93	Samples were collected near suspected disposal pit location to investigate surface soil contamination.
	3	08/25/93	Samples collected for TOC analysis.
	1	08/25/93	Geotechnical sample was collected and sent for grain size and Atterberg limits analyses to provide data on the nature of the surface soils on site.

Source: Ecology and Environment, Inc. 1994.

Subsurface Soil Sampling

E & E completed one borehole using a drill rig and the hollow stem auger and split spoon method of drilling and sampling. The borehole, E3-P38-B01, was located in the center of a small depression along the southern edge of the old railroad bed that runs northeast-southwest across the southern portion of the Annex. The depression is approximately 15 feet due north of a concrete foundation, which is visible where it extends out into the old railroad bed. The boring was sampled at depths between 4 to 6 feet BGS and 9 to 11 feet BGS. Samples were collected to investigate subsurface contamination and characterize

the nature of subsurface soils. Because there had been laboratory error, the boring was resampled at both depths in December 1993 and analyzed for BNAs.

An additional two borings were sampled by using a gas-powered hand auger, to investigate subsurface contamination at two locations near the depression. The first power auger location, borehole E3–P38–B02, lies approximately 250 feet north of the concrete foundation and depression that were described above. The location was chosen because field observations had indicated a wide, flat area along the railroad bed that appeared to be ideal for loading/unloading and inspection of railroad cars and their contents. The subsurface samples were used to investigate the presence of subsurface contamination. The second boring, E3–P38–B03, was in the center of the concrete foundation and was done to investigate whether burning or disposal activities occurred there. Samples were collected at depths of 1.5 feet BGS and 4.5 feet BGS. No unusual debris or soil characteristics were encountered.

Surface Soil Sampling

Three surface soil samples were collected from three points aligned in a semicircle surrounding the depression that was sampled during the subsurface investigation of boring E3–P38–B01. The samples were collected from areas that had obvious discoloration or stressed vegetation, or were lying in surface drainage channels. All samples were sent for TOC analysis and the sample collected at location E3-P38-S01 was also sent for grain size analysis. Data from the samples was used to characterize surface contamination at the site, and to assess if the surface soils are a source of other contamination and whether remedial action is appropriate.

3.2.7.7 Nature and Extent of Contamination

Analysis of the three surface soil samples collected at Site P38 indicated the presence of arsenic at levels above preliminary screening values. The surface concentrations ranged from 200 μg/g at sample location E3-P38-S01 to 130 μg/g at E3-P38-S02, and 98 μg/g at E3-P38-S03. All three concentrations are above the MCP GW-1/S-1 and GW-3/S-3 screening levels of 30 μg/g. These elevated arsenic concentrations in the surface soils are consistent with the results for Site P28, the Rocket Range/Railroad Classification Yard and suggest the same or similar sources of arsenic contamination. A summary of all detections above screening levels is provided in Table 3-41. In addition, a full summary of analytical results is provided in Tables 3-42 and 3-43 following Section 3.2.7.8, Conclusions and Recommendations for Site P38.

Low levels of pesticides and TPHC were also detected in the surface soils at Site P38. The three sample locations lie in a depression off the western edge of the access road which travels the length of the classification yard. The pesticide concentrations are all below any identified screening values and are consistent with past widespread spraying practices at the Annex. The TPHC concentrations at each of the three sample locations are well below any screening values and are at levels consistent with their proximity to the abandoned railroad classification yard. No other contaminants were detected at concentrations above screening values in the surface soils at Site P38.

Arsenic was also detected in the subsurface soils in boring E3-P38-B03. The boring was located in the center of a concrete foundation which lies on the western edge of the access road. The sampling results suggest the foundation was not a guard shack, as originally supposed after review of historic site maps, but may have been a maintenance or equipment storage shed. Arsenic (51 μg/g) was found at a depth of 1.5 feet BGS. This concentration is slightly above the screening level of 30 μg/g for MCP Level 1 and Level 3 groundwater and soils. DDT and its degradation products DDD and DDE were also detected in the boring sample collected from a depth of 1.5 feet BGS. Of these compounds, DDT (0.780 μg/g) was the highest detected pesticide but still was well below the MCP GW-1/S-1 screening level of 2 μg/g. The pesticide levels were consistent with other sampling results throughout the Annex, and lend substance to the possibility that the concrete foundation was used as a maintenance and storage shed. No other contaminants at levels elevated above screening values were detected in boring E3-P38-B03.

Borings E3-P38-B01 and E3-P38-B02 showed no contaminants at concentrations elevated above screening values. The first boring (E3-P38-B01) was located in the center of the depression where the three surface soil samples were collected. The relatively low concentrations of arsenic (a high of 6.66 μg/g) in the subsurface samples indicated that the contamination detected in the three surface samples has not affected the subsurface soils. Boring E3-P38-B02 was completed in the wide, open, flat area in the southern portion of the classification yard (Site P28). The sample results did not indicate the presence of any contaminants elevated to above screening levels.

Table 3-41

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P38

Medium (Units)	Compound	Maximum Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
SOIL (Subsurface) (μg/g)	Arsenic	10	30	MCP GW-1/S-1[1]	51.0	E3-P38-B03	1/3
SOIL (Surf.) (μg/g)	Arsenic	10	30	MCP GW-1/S-1	200	E3-P38-S01	3/3

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

3.2.7.8 Conclusions and Recommendations

Due to the proximity of the Rocket Range/Railroad Classification Yard (Site P28) and the Inspection Pit (Site P38), and the similarity of sampling results (arsenic in surface soils), the recommendations for future investigations at Site P38 are included in the summary and recommendations for the Rocket Range/Railroad Classification Yard (Site P28).

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-42
Chemical Summary Report For Subsurface Soils
Site: P38
Units: UGG

	Site ID	E3-P38-B01	E3-P38-B01	E3-P38-B02	E3-P38-B02	E3-P38-B03	E3-P38-B03
	Field Sample ID	EXP38011	EXP38012	EXP38021	EXP38022	BXP38031	BXP38032
	Sample Date	09/24/93	09/24/93	09/24/93	09/24/93	12/01/93	12/01/93
Test	Parameter / Depth	1.5 ft.	4.5 ft.	1.5 ft.	4.5 ft.	0.0 ft.	0.0 ft.
TAL METAL	Aluminum	3420	3530	3860	7520		
	Antimony	0.810 J!	0.315 J	0.332 J	0.275 J		
	Arsenic	51.0 !@	6.55	18.0 !	5.77		
	Barium	15.9	11.2	11.2	30.9 !		
	Beryllium	0.193 JL	0.210 JL	0.204 JL	0.315 JL		
	Cadmium	< 0.500	< 0.500	< 0.500	0.313 J		
	Calcium	249 J	214 J	259 J	327 J		
	Chromium	5.25	6.53	5.44	20.5 !		
	Cobalt	3.62	4.14	4.07	6.79 !		
	Copper	7.51	6.87	6.31	7.70		
	Iron	4840	4890	4660	9980		
	Magnesium	797	857	785	2460 !		
	Manganese	94.0	120 !	131 !	169 !		
	Nickel	5.21	6.87	5.92	13.2 !		
	Potassium	632 !	534 K	464 K	1360 !		
	Vanadium	8.13	7.80	7.05	16.4		
	Zinc	14.0 K	16.4 K	13.4 K	19.2 K		
TCL BNA	Fluoranthene	0.780	< 0.660	< 0.660	< 0.660	< 0.330	< 0.330
TCL Pest	Endosulfan Sulfate	0.002 JC	0.002 JC	0.002 U	0.001 JC		
	P,P-DDD	0.360 C!	0.006 KC	0.004 BU	0.002 BJU		
	P,P-DDE	0.057 C	0.008 KC	0.002 BJU	< 0.002		
	P,P-DDT	0.780 C!	0.015 C	0.008 C	0.002 JU		
	alpha-BHC	0.001 JU	0.001 JC	0.001 JU	0.001 JU		
	alpha-Chlordane	0.004 C	0.002 JU	0.000 JU	< 0.002		
	beta-BHC	0.002 JU	< 0.002	0.001 JU	0.001 JC		
TPHC	Total Petroleum Hydrocarbons	17.5 J	< 20.0	< 20.0	< 20.0		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-42
Chemical Summary Report For Subsurface Soils
Site: P38
Units: UGG

Test	Parameter						
	Site ID	E3-P38-B04	E3-P38-B04				
	Field Sample ID	BX380101	BX380102				
	Sample Date	08/10/93	08/10/93				
Test	Parameter Depth	4.0 ft.	9.0 ft.				
TAL METAL	Aluminum	8400	5200				
	Antimony	< 0.500	< 0.500				
	Arsenic	6.66	5.25				
	Barium	10.7	10.1				
	Beryllium	0.330 J	0.186 J				
	Cadmium	0.425 J	0.292 J				
	Calcium	< 500	< 500				
	Chromium	11.0 K	9.03 K				
	Cobalt	4.95	3.69				
	Copper	6.80	8.16				
	Iron	10000	7200				
	Magnesium	1630	1580				
	Manganese	150 !	62.7				
	Nickel	10.1	9.29				
	Potassium	499 K	613				
	Vanadium	11.7	7.85				
	Zinc	14.8 K	15.9 K				
TCL BNA	Fluoranthene	< 0.330 R	< 0.330 R				
TCL Pest	Endosulfan Sulfate	< 0.002	< 0.002				
	P,P-DDD	< 0.002	< 0.002				
	P,P-DDE	< 0.002	< 0.002				
	P,P-DDT	< 0.002	< 0.002				
	alpha-BHC	< 0.001	< 0.001				
	alpha-Chlordane						
	beta-BHC	< 0.001	< 0.001				
TPHC	Total Petroleum Hydrocarbons	< 20.0	< 20.0				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-43
Chemical Summary Report For Surficial Soils
Site: P38
Units: UGG

	Site ID	E3-P38-S01	E3-P38-S02	E3-P38-S03			
	Field Sample ID	SX3801X1	SX3802X1	SX3803X1			
	Sample Date	08/25/93	08/25/93	08/25/93			
Test	Parameter .						
TAL METAL	Aluminum	7060	6160	7290			
	Antimony	3.66 J!	1.86 J!	1.33 K!			
	Arsenic	200 !@	130 !@	98.0 !@			
	Barium	22.6	15.4	22.0			
	Beryllium	0.261 J	0.196 J	0.244 J			
	Calcium	362 J	< 500	1220 !			
	Chromium	12.0	16.4 !	15.3 !			
	Cobalt	5.98 K	5.55 K	6.54 K!			
	Copper	10.3	7.84	20.0 !			
	Iron	10300	9550	14000 !			
	Lead	22.0 J	22.0 J	21.0 J			
	Magnesium	2050	2350 !	2750 !			
	Manganese	190 !	154 !	153 !			
	Nickel	11.6 !	11.2 !	11.7 !			
	Potassium	897 !	738 !	1340 !			
	Selenium	< 0.200 J	0.207 J	0.257 J			
	Thallium	0.359 J	< 0.500	< 0.500			
	Vanadium	16.4	16.2	20.6			
	Zinc	45.4 K!	21.4 K	24.3 K			
TCL BNA	Benzo(b)fluoranthene	0.330 L	< 0.330 L	0.091 JL			
	Chrysene	0.260 JL	< 0.330 L	< 0.330 L			
	Fluoranthene	0.310 JL	< 0.330 L	0.076 JL			
	Phenanthrene	0.150 JL	< 0.330 L	< 0.330 L			
	Pyrene	0.260 JL	< 0.330 L	< 0.330 L			
TCL Pest	Endosulfan,B	0.003 C	< 0.002	< 0.002			
	P,P-DDD	0.040 C	0.018 C	0.034 C			
	P,P-DDE	0.160 C!	0.031 C	0.079 C			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 3-43
Chemical Summary Report For Surficial Soils
Site: P38
Units: UGG

	Site ID	E3-P38-S01	E3-P38-S02	E3-P38-S03			
	Field Sample ID	SX3801X1	SX3802X1	SX3803X1			
	Sample Date	08/25/93	08/25/93	08/25/93			
Test	Parameter .						
TCL Pest	P,P-DDT	0.160 C	0.048 C	0.130 C			
TPHC	Total Petroleum Hydrocarbons	29.8	47.5	49.0			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

3.2.8 Site P39 — Dump Area

Site P39 was identified as a result of a 1993 OHM site reconnaissance, which encountered scattered debris and drums. Figure 3-9 is a map of the site.

3.2.8.1 Site Location

Site P39 is in the southwestern corner of the installation. It is reached by an unpaved road that diverges northeast from Firehouse Road. The site which can also be reached by heading east on a trail or old road behind the weather station at Site P48. The site comprises a partially cleared area and a dumping ground on sloping terrain on the side of a wetland. Metal pipes, cables, wood, engine parts, glassware, and a crushed drum are some examples of the items included in the refuse at Site P39.

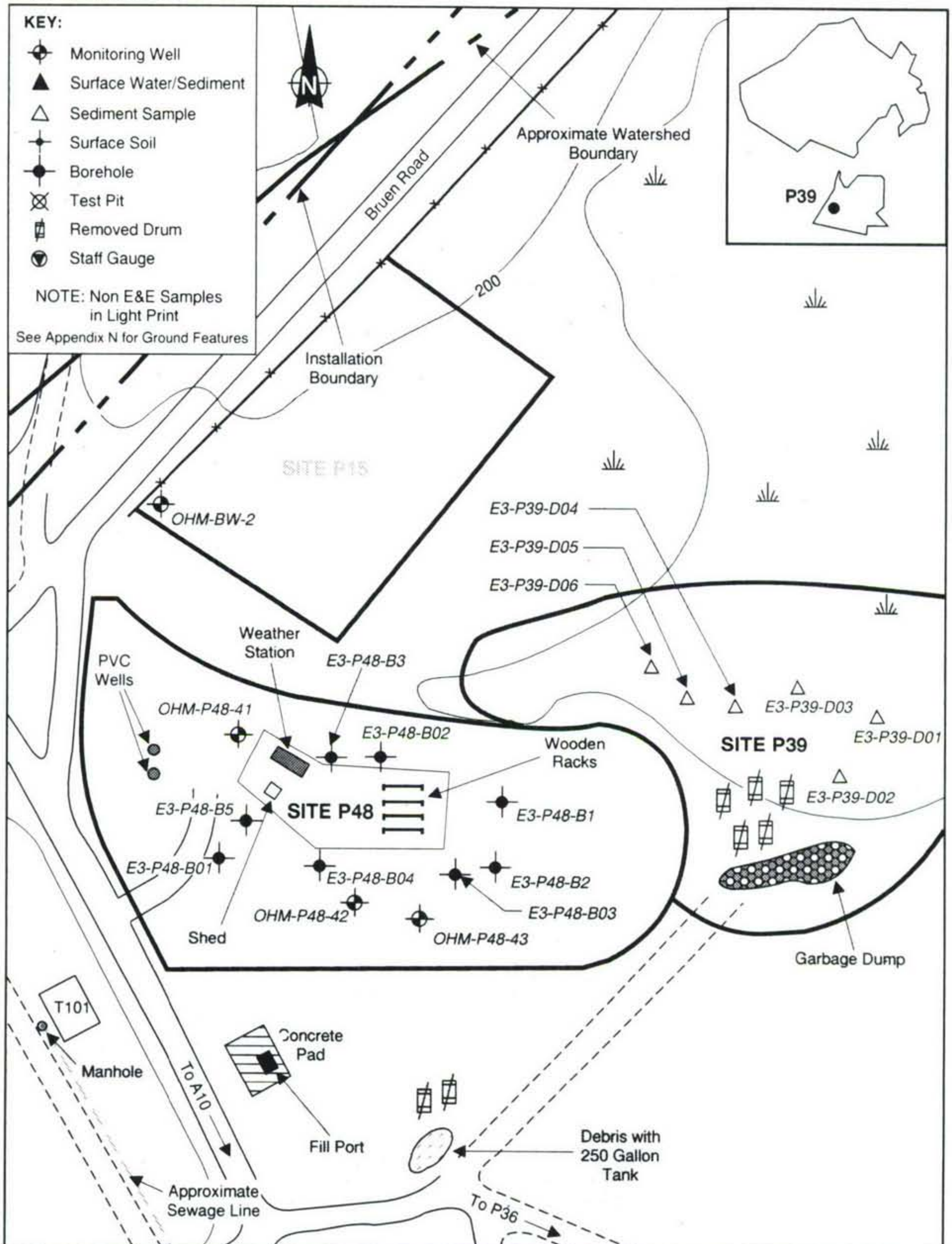
3.2.8.2 Physical Characteristics

Site P39 lies on an area of glacial outwash sand and gravel. A small wetland is adjacent and extends partly into the northeastern portion of Site P39. Surface elevation in the area is approximately 195 feet AMSL. No wells were installed at Site P39; however, judging from the proximity of the wetland, groundwater is very shallow. During rainy periods, the water table in portions of the area may rise above the ground surface and groundwater is always within a few feet of the surface even during dry periods when the wetland dries up.

Three test pits (P39TPA, P39TPB, and P39TPD) were excavated in Site P39 in 1991 by OHM Corporation. A depth of six feet was achieved in the deepest of the pits (P39TPD). Soil classification logs for each pit show a 1 to 2.5 foot thick surface layer of humus underlain by outwash material consisting of a poorly sorted sand, silt, and gravel mixture. No other subsurface explorations were undertaken in the site. Six sediment samples (E3-P39-D01 to D06) were collected and submitted for grain size and Atterberg limits analyses. Sediment sample E3-P39-D01 was identified as a moderately plastic, poorly graded sand with silt. Samples E3-P39-D02 and E3-P39-D03 were identified as highly plastic, well-graded sand with silt. Samples E3-P39-D04 and E3-P39-D05 were classified as highly plastic, silty sand and sample E3-P39-D06 was identified as non-plastic, poorly graded sand. Appendix D provides complete geotechnical laboratory reports. Based on interpretation of a seismic survey, depth to bedrock is approximately 50 feet. The bedrock material is thought to be amphibolitic schist of the Marlboro Formation.

Surface water flows northeast from the site to the adjacent isolated wetland. There is no apparent surface drainage from the wetland. Runoff remains in the wetland as standing water until the water table recedes below the ground surface, allowing for infiltration of all surface water. Water levels collected from adjacent Site P48 wells and Perlmutter's 1962 study indicate that groundwater flow is southwest or west/southwest from the site and discharges to wetlands south of the railroad, which are drained by tributaries of Hop Brook.

11: SUDBURY\UC6_P15.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-9 MAP OF SITE P39 DUMP AREA

3.2.8.3 Ecological Characterization

A dense forest of mixed oaks and hardwood trees covers most of the site, including the wetland area. On the southeastern corner of the site, immediately adjacent to the dirt access road, there is a small stand of pitch pine and oak trees, an association of trees known as pine barrens. A larger pine barren area lies approximately 200 feet southwest of the site (Aneptek 1991, Figure 1).

The on-site wetland is seasonally saturated and vegetated with mixed oak trees (USDOI 1977). Groundwater flows southwest towards several wetlands south of the Annex (E & E 1993). These wetlands, saturated and vegetated with deciduous trees, are located approximately 1,000 feet from the site and are potential receptors of groundwater from Site P39.

This area provides three different habitat types: upland oak forest, pine barren, and forested wetland. Pine and oak trees are important to wildlife as waterfowl, upland gamebirds, songbirds, small mammals, and deer rely on pine seeds and acorns for food (Martin *et al.* 1951). In addition, the tannin-rich, slowly decaying oaks leaves provide a thick mat for reptiles and amphibians to find food in or use as shelter. Oaks and pines also serve as cover for deer and rabbits during the winter. Forested wetlands combine abundant nutrients, diverse woody species, and available water. Consequently, such areas attract a diverse array of aquatic and upland species, as well as species specifically adapted to wetlands.

There are no records of rare, threatened, or endangered species associated with this site. However, pine barren stands, which are threatened elsewhere by development pressures and fire exclusion practices are considered unique remnant habitats in Massachusetts (Aneptek 1991, NHESP 1992).

3.2.8.4 Site History

This site was identified during a 1991 site reconnaissance because scattered debris was found at the end of an access road leading from Site A10. Scrap metal was seen, and drums were noted as partially buried and underwater in a swampy area. Facility maps show that a road led to this site in 1955 and that No. 4 Fire Siren was near the site. A facility map shows that in 1962, No. 3 Fire Siren was at the end of the road. Later maps of the area do not indicate any activity at the site.

3.2.8.5 Results of Previous Investigations

A detailed description of the work performed at Site P39 is included in Section 7.48 of the January 1994 *Final Site/Remedial Investigation Report* (OHM 1994). An SI was conducted at Site P39 and included a geophysical study, test pit excavations with subsurface sampling, and surface water and sediment sampling.

The geophysical survey conducted in 1991 suggested the presence of shallow, buried material at the site. As a result, three test pits were excavated. No PID or radiological readings above background were detected. Test pits revealed rusted strips of metal, broken bottles, and corrugated metal. Grab samples were collected at each pit.

All soil samples were analyzed for TCL volatile and semivolatile organics, TCL pesticides/PCBs, TAL metals, explosives, and chlorinated herbicides. Pesticides were found in a test pit subsurface soil sample (P39TPA1) and in a sediment sample (P39SD1). Of most significance was the presence of DDT (0.153 μg/g) and its degradation products and dieldrin (0.282 μg/g) in P39SD1. Sediment sample P39SD1 also contained the highest concentration of eight PAHs of all the samples collected at the Annex to date. Of all surface water samples taken to date at the Annex, P39SW1 and P39SW2 showed the highest concentrations of zinc (109 μg/L in P39SW1) and endosulfan sulfate (0.066 μg/g in P39SW2). Lead (8.53 μg/L and 5.26 μg/L) was also present in these two surface water samples.

3.2.8.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and TPHC. All sediment samples were sent for TOC and grain size analysis. A summary of Phase II Sampling Activities at Site P39 is provided as Table 3–44.

Table 3-44

PHASE II FIELD EFFORTS FOR SITE P39 — DUMP AREA

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Sediments	6	08/11/93 08/13/93	Samples were collected to investigate contamination in the wetland and wetland area due to past disposal activities.
Sediments	6	08/11/93 08/13/93	Geotechnical samples were collected to investigate the nature of the wetland soils and their impact upon potential contaminant migration.
	6	08/11/93 08/13/93	Samples were collected for TOC analysis.

Source: Ecology and Environment, Inc. 1994.

Geophysical Investigations

EM31 and magnetometer surveys were conducted across the wetland in the northern and eastern portions of Site P39. The surveys verified the locations of surface debris and other visual anomalies identified during earlier EM31 and magnetometer surveys conducted by OHM. E & E's surveys also expanded the investigation area to further identify buried debris and other subsurface anomalies.

Sediment Sampling

Six sediment samples were collected from six locations across the wetland to investigate whether surface contamination had resulted from past disposal activities near the bank of the wetland. The samples were taken from low lying areas where water accumulates and contaminants may settle. Because they are near surface drainage channels, the locations were also chosen to assess the impacts of surface runoff on the wetland area. All samples were sent for TOC analysis. In addition, geotechnical samples were also collected from each location to obtain data on the nature of the wetland soils and their impact on contaminant migration in the surface water pathway.

3.2.8.7 Nature and Extent of Contamination

Analysis of six sediment samples collected in the wetlands at Site P39 indicates the presence of copper, lead, TPHC, DDD, and DDE, at concentrations elevated above screening levels. Lead was found in four of the six samples above the LEL of 31 μg/g developed by the Ontario MOE. The concentrations ranged from 34.7 μg/g, just above the LEL at sediment sampling location E3-P39-D05 to 110 μg/g at E3-P39-D06). All of the six lead concentrations were at or below the NOAA ERM screening level of 110 μg/g. The sampling locations were in depressions and other areas of the wetlands where water accumulated and sediments most likely settled. The elevated lead levels are probably due to runoff from the metal debris found all along the banks of the wetlands. TPHC was also detected at two sample locations, E3-P39-D04 (564 μg/g) and E3-P39-D06 (741 μg/g), slightly above the most restrictive MCP GW-1/S-1 soil screening level of 500 μg/g. The concentrations are well below the GW-3/S-3 soil screening level of 5,000 μg/g, and are probably due to runoff from the household debris and garbage lying upgradient of the wetlands. Previous surface water and sediment sampling conducted by OHM confirms the presence of copper and lead at levels slightly above Ontario MOE LEL screening values. A summary of all the detections above screening levels for Site P39 is provided in Table 3-45. A complete summary of analytical results for Site P39 is provided following Section 3.2.8.8, Conclusions and Recommendations, in Table 3-46.

The pesticide degradation product DDE was found at concentrations above the preliminary screening level. The highest concentration (0.059 μg/g) was found in samples from sample location E3-P39-D02 near the center of the eastern portion of the wetland. The concentration is above the NOAA ERL screening level of 0.002 μg/g, but is below the NYSDEC SQC screening level of 0.636 μg/g. The NYSDEC screening value takes into account the heavy organic carbon content of the wetland sediments and is a site-specific criteria. DDE was found in samples from E3-P39-D01 at a concentration of 0.006 μg/g, slightly above the restrictive NOAA ERL screening level of 0.002 μg/g. The DDE concentration is well below the NYSDEC SQC screening level of 0.666 μg/g. Previous sampling of the wetlands by OHM confirms the presence of DDE and several other pesticides (dieldrin, endosulfan sulfate, and DDT) not found during E & E's sampling. The pesticide concentrations found during the sampling events by both E & E and OHM are consistent with levels associated with past spraying practices at the Annex.

Table 3-45

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P39

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency above screen level
SED ($\mu g/g$)	Copper	6.33	16	Ontario MOE LEL[1]	16.9	E3-P39-D04	1/6
	Lead	4.48	31	Ontario MOE LEL	110	E3-P39-D06	4/6
	DDD	--	0.002	NOAA ERL[2]	0.006(est.)	E3-P39-D01	1/6
	DDE		0.002	NOAA ERL	0.059(est.)	E3-P39-D02	3/6
	TPHC	16.6	500	MCP GW-1/S-1[3]	741	E3-P39-D06	2/6

[1]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[2]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range - Low.
[3]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

3.2.8.8 Conclusions and Recommendations

The metals, lead and copper, were found in sediments at concentrations slightly above screening levels at locations near debris piles or in runoff channels. Total petroleum hydrocarbons (TPHCs) were also found above soil screening values. The pesticide concentrations found in the wetland sediments are consistent with the past, widespread spraying practices used at the Annex, and are at levels below the site-specific screening levels (NYSDEC SQC). It appears that the dumping and debris contributed to some limited metals and petroleum contamination of th wetland sediments, further action is recommended at this site including consideration of a removal action. The potential removal of any debris and sediment from the wetland area would have to be done with the possible impact on the wetland and associated vegetation in mind. The damage associated with a removal action may well exceed any value of the cleanup. Additional sampling is not recommended as the contaminant concentrations from past dumping practices near Site P39 have been sufficiently measured. In addition, extensive geophysical investigations have identified the extent of the disposal area and located subsurface debris throughout the area.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 3-46
Chemical Summary Report For Sediments
Site: P39
Units: UGG

	Site ID	E3-P39-D01	E3-P39-D01	E3-P39-D01	E3-P39-D01	E3-P39-D02	E3-P39-D03
	Field Sample ID	DD3901X1	DD3901X1	DX3901X1	DX3901X1	DX3902X1	DX3903X1
	Sample Date	08/11/93	08/12/93	08/11/93	08/12/93	08/11/93	08/11/93
Test	Parameter .						
TAL METAL	Aluminum	1540		1810		1920	1880
	Arsenic	1.98		2.54 !		1.44	2.71 !
	Barium	< 5.00		< 5.00		29.9 !	30.7 !
	Calcium	< 500		< 500		< 500	< 500
	Cobalt	< 1.00		< 1.00		< 1.00	< 1.00
	Copper	4.35 J		4.98 J		6.81 !	8.19 !
	Iron	< 350		1990		1350 J	1850
	Lead	22.5 !		27.9 !		24.3 !	72.0 !#
	Manganese	6.37 J		11.2 J		28.6	23.0 J
	Nickel	5.87		5.22 J		6.30 !	7.01 !
	Potassium	< 200		< 200		395 KJ	438 KJ
	Selenium	1.07 !		1.07 J!		< 0.200	1.12 !
	Vanadium	5.77 J		9.02 J		9.16	14.1
	Zinc	38.2 !		45.3 !		78.6 !	83.3 !
TCL Pest	P,P-DDD	< 0.020		0.006 JCL#		< 0.020	< 0.040
	P,P-DDE	< 0.020		0.010 JCL#		0.059 JCL#	< 0.040
TCL VOA	Carbon disulfide		0.023 BJ		0.080	0.023 B	0.055 K
TOC	Total Organic Carbon	656000		666000		636000	676000
TPHC	Total Petroleum Hydrocarbons	117 !#		375 !#		283 !#	351 !#

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 3-46
Chemical Summary Report For Sediments
Site: P39
Units: UGG

Test	Parameter	E3-P39-D04	E3-P39-D05	E3-P39-D06			
	Field Sample ID	DX3904X1	DX3905X1	DX3906X1			
	Sample Date	08/11/93	08/11/93	08/11/93			
TAL METAL	Aluminum	2670	1970	3040			
	Arsenic	3.59 !	2.22 !	2.52 !			
	Barium	54.7 !	30.7 !	43.1 !			
	Calcium	1930 J!	< 500	< 500			
	Cobalt	< 1.00	< 1.00	2.46 J			
	Copper	16.9 !#	8.44 !	10.3 !			
	Iron	4000	1940	2160			
	Lead	49.0 !#	34.7 !#	110 !#			
	Manganese	42.8	16.4 J	18.3 J			
	Nickel	6.13 !	< 1.00	7.06 !			
	Potassium	587 J	409 KJ	526 KJ			
	Selenium	1.27 !	1.27 !	1.15 !			
	Vanadium	17.2 !	8.68 J	12.5			
	Zinc	113 !	59.9 !	44.3 !			
TCL Pest	P,P-DDD	< 0.040	< 0.020	< 0.040			
	P,P-DDE	< 0.040	0.057 JCL#	< 0.040			
TCL VOA	Carbon disulfide	< 0.005	0.032 K	< 0.005			
TOC	Total Organic Carbon	620000	663000	616000			
TPHC	Total Petroleum Hydrocarbons	564 !@#	213 !#	741 !@#			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

3.2.9 Site P48 — Fuel Bladder Area

Site P48 was identified as a result of an interview with a former Natick Laboratory employee, who reported that testing of POL bladders occurred at the site from 1959 until 1965 (Dames and Moore 1991). Figure 3-10 is a site map showing the area.

3.2.9.1 Site Location

Site P48 is on the southwestern corner of the Annex, immediately east of the intersection of Firehouse Road and Bruen Road. Across from an old building (T101), a paved road diverges from Firehouse Road and leads northeast into a cleared area. In this area, enclosed within a barbed wire fence, are wooden test racks used for clothing durability testing and a weather station office trailer.

About 300 feet southeast of the weather station and along Firehouse Road, there is a small clearing with a 45 foot by 30 foot concrete foundation. Some metal is scattered on the foundation, a metal, ladder-like structure lies in one corner, and a wooden tower with a sign marked "diesel" stands on the side of the foundation closest to Firehouse Road. To the side of the foundation there is a 20 foot by 12 foot concrete tank with a protruding metal port.

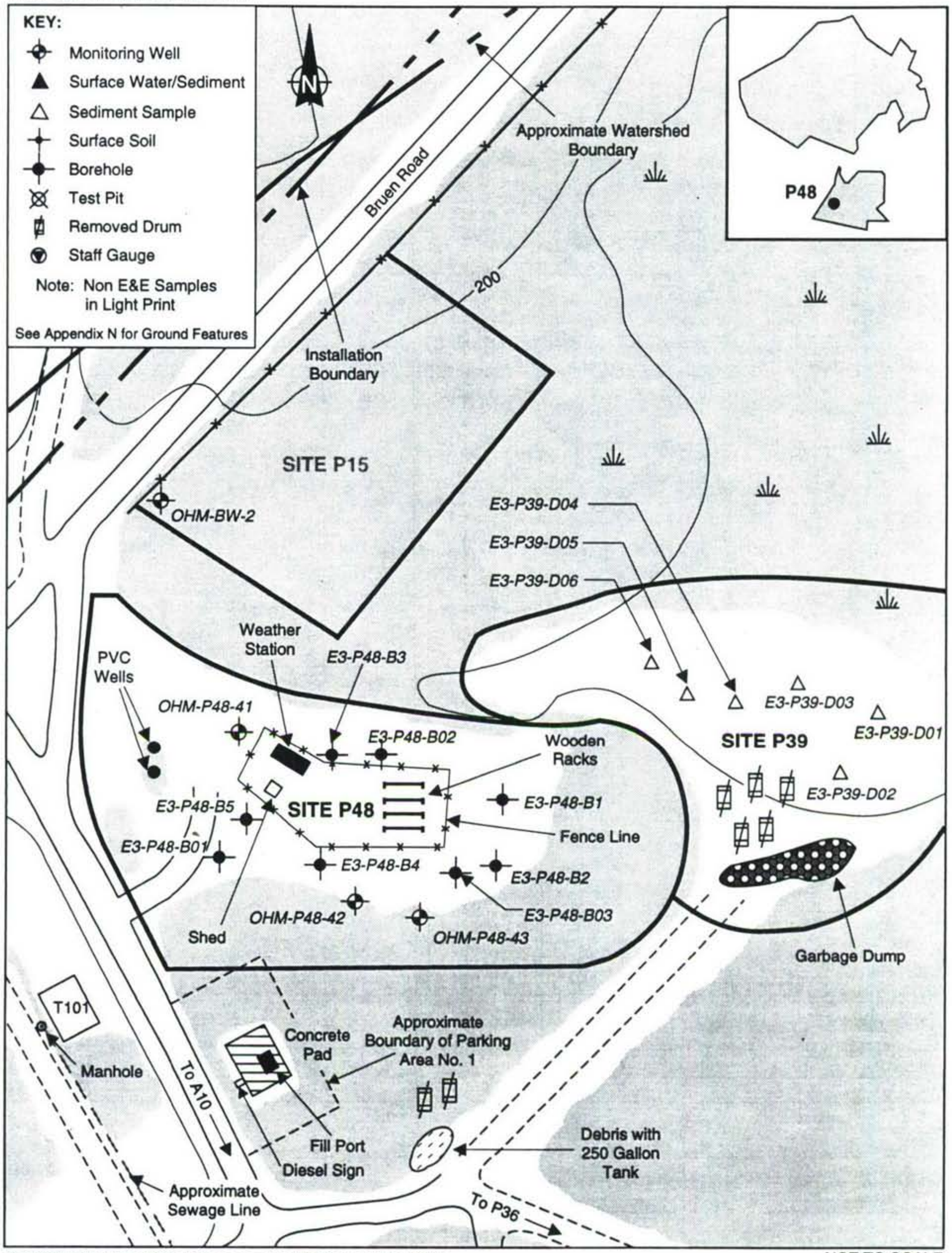
3.2.9.2 Physical Characteristics

Site P48 is in an area of glacial outwash sand and gravel. Surface elevation at the area is approximately 196 feet AMSL. Average groundwater elevation across the area is 187.5 feet AMSL.

In 1992, OHM installed five boreholes at Site P48. Each was drilled to a depth of eight feet and encountered outwash material consisting of poorly sorted sand, silt, and gravel. Three monitoring wells (OHM-P48-41, OHM-P48-42, and OHM-P48-43) were also installed by OHM Corporation in 1992. At each of these locations, the poorly sorted outwash material extended to a depth of 15 to 16 feet and was underlain by a layer of fine sand and silt with fine gravels. A total depth of 12 feet was reached at wells OHM-P48-41 and OHM-P48-42. Well OHM-P48-43 reached a depth of 18 feet. Three additional borings installed by E & E in 1993 confirmed the presence of poorly sorted outwash material through a total depth of 11 feet at each location. No geotechnical samples were collected at this site. Bedrock was not encountered during any subsurface explorations; however, interpretation of a seismic survey indicates that depth to bedrock is approximately 55 feet (Perlmutter 1962). The bedrock material is projected to be amphibolitic schist of the Marlboro Formation (Hansen 1956).

In 1992, OHM Corporation conducted slug tests on the three area wells (OHM-P48-41, OHM-P48-42, and OHM-P48-43). An average transmissivity of 500 $feet^2$ per day was calculated for the three wells based on an average aquifer thickness of 45 feet. The estimate of aquifer thickness was based on Perlmutter's study and water-level measurements taken at the time of the tests. This low transmissivity number is comparable to

11: SUDBURY\NFADD\UC6_P48.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 3-10 MAP OF SITE P48 FUEL BLADDER AREA

other calculated transmissivities for outwash material throughout the watershed and the entire facility.

Surface water flows south from Site P48, crossing Site A10 toward the railroad track. Upon reaching the railroad, flow turns southeast and runs parallel to the track until reaching a wetland draining south under the railroad into a tributary to Hop Brook. Water levels, hydrogeologic data, and information collected from Perlmutter's study indicate that groundwater flow is southwest under the railroad and discharges to wetlands ultimately drained by Hop Brook (Perlmutter 1962).

3.2.9.3 Ecological Characterization

Situated in a meadow overgrown with grasses and forbs, the site includes a trailer and wooden racks surrounded by a barbed wire fence. Immediately to the northwest of the clearing there is a dense growth of red pines ranging from 40 to 60 feet in height. Pine barrens, a mixture of pitch pine and oak trees, occur along the eastern and southeastern edge of the site. To the northeast of the site there is a mixed oak forest (LFS 1983 and Aneptek 1991).

The topography of the area indicates that surface water runoff from the site flows to the south. Similarly, groundwater flows southeast towards a wetland approximately 1,000 feet from the site, between the Annex boundary and Hop Brook (E & E 1993). This wetland is seasonally saturated and vegetated with deciduous trees. There is another forested wetland 500 feet north of the site; however, this wetland is considered to be upgradient from Site P48 and is unlikely to be affected by conditions at the site.

This area provides a variety of upland habitats, including meadow, pine barren, red pine forest, and mixed oak forest. Meadows usually provide habitat for deer, ground-nesting birds, small mammals such as mice, and raptors. The pine and oak trees sustain a community of songbirds, upland game birds, and several species of small mammals which feed on pine seeds, acorns, needles, leaves, buds, and twigs (Martin *et al.* 1951). Fallen oak leaves provide shelter and food to several species of reptiles and insects. Furthermore, the dense canopy closure of pines also serve as cover to deer and rabbits in the winter. Like other wetlands of its type, the forested wetland southeast of the site is expected to attract a diverse array of aquatic and upland species, as well as species specifically adapted to wetlands.

There is no evidence of any rare, threatened, or endangered species associated with the site. However, pine barrens, threatened by development pressures and fire exclusion practices, are considered unique remnant habitats in Massachusetts (Aneptek 1991; NHESP 1992).

3.2.9.4 Site History

A former Natick Laboratory employee stated that this site was used from 1959 to 1965 for testing of POL fuel bladders (Interview 1992b). The testing was reportedly done in the area between the current fenceline and the edge of Bruen Road. The POL bladders

reportedly ranged up to 500 gallons in size and were sometimes partially buried in the ground as part of field exercises. Some spillage of fuels, including gasoline and aviation fuel, reportedly occurred. Two pits or trenches were dug along the tree line at the time of testing to control spills.

Facility maps from 1955 and 1962 note that "Parking Area No. 1" was located along the west side of the site near the former barracks area. No other reference to activity at the site could be located. An aerial photograph from 1963 indicates that the area was clear of vegetation.

The area is currently surrounded by a fence and is used for the testing of weather resistance of certain clothing materials. Textiles are left exposed to the elements on a series of wooden racks within an enclosed fenced area just east of Building 2. Building 2 contains a small meteorology station.

3.2.9.5 Results of Previous Investigations

A soil-gas survey was conducted by the Northeast Research Institute for Dames and Moore in 1990. Results indicated generally low flux-levels of BTEX, moderate to heavy weight PHCs, TCE, and perchloroethylene (PCE) (USAEC 1990). The wide distribution and apparently sparse amounts of the compounds found are characteristic results of releases that occurred a long time ago.

The details of an SI conducted by OHM in 1992 are included in Section 7.57 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). This investigation included a geophysical study, drilling of boreholes and collection of subsurface samples, installation of monitoring wells and groundwater sampling, and collection of surface water and sediment samples.

In March 1992, three shallow monitoring wells were installed to characterize the groundwater quality beneath Site P48. These wells were sampled in June and October 1992. No significant levels of contaminants were detected in groundwater samples. Water level measurements indicate a hydraulic gradient and groundwater flow to the south-southwest towards an off-site wetland south of the railroad tracks.

During OHM's site reconnaissance, two PVC pipes protruding from the ground and a tank were discovered in the treeline north of the area. Geophysical studies also located surface scrap metal, utility poles, and water valves.

In 1992, boreholes were drilled in locations selected on criteria found after evaluation of the Northeast Research Institute's soil-gas survey results. Subsurface soil samples were collected for these borings and analyzed for TCL volatile and semivolatile organics, TCL pesticides/PCBs, TAL metals, and explosives. The only semivolatile compound detected at concentrations above background was bis(2-ethylhexyl) phthalate (1.6 μg/g) in the subsurface soil sample taken at the 4 to 6 foot interval from P48B5. The only metal found above background levels was cobalt at a highest concentration of 6.23 μg/g.

3.2.9.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation were analyzed for TCL volatiles and TPHC. A summary of Phase II Sampling Activities at Site P48 is provided as Table 3-47.

Table 3-47

PHASE II SAMPLE EFFORT FOR SITE P48 — FUEL BLADDER AREA

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	3	08/30/93	Samples were collected to characterize groundwater quality and investigate contaminant migration in three wells downgradient of P48.
Subsurface Soils	6 from 3 borings	08/10/93 08/11/93 08/16/93	Samples were collected to investigate subsurface contamination from previously identified locations immediately surrounding the fuel bladder testing area.
	3	08/10/93 08/11/93 08/16/93	Samples were collected to characterize the nature of subsurface soils in the area and their impact upon contaminant migration through the groundwater pathway.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

To characterize groundwater quality and investigate the presence of groundwater, contamination downgradient of Site P48, E & E sampled three existing wells: OHM-P48-41, OHM-P48-42, and OHM-P48-43. All three wells were sampled in August 1993 during the first groundwater sampling event. All samples collected were unfiltered, in contrast to previous groundwater sampling conducted by OHM.

Well OHM-P48-41 is located on the northwest corner of the fenced zone that encircles the fuel bladder testing area. The well's location allows for the monitoring of any contaminant plume which may be migrating from Site P48 to White Pond, the Town of Maynard's drinking water source. Wells OHM-P48-42 and OHM-P48-43 are located along the southern edge of the fuel bladder testing area to monitor any contaminant plumes which may be associated with anomalies measured during the previous soil-gas survey conducted by OHM. The monitoring wells provide data to characterize the groundwater pathway as a potential contaminant source.

Water level measurements confirm a groundwater flow direction to the south-southwest, towards an off-site wetland south of the Boston and Maine Railroad tracks (see Table 3-2).

Subsurface Sampling

Three borings were completed in areas OHM recommended based on the results of a soil-gas survey conducted in 1990. The survey identified three locations that recorded significant levels of TPHC contamination immediately outside the fenced fuel bladder testing area. E & E's three borings (E3-P48-B01), E3-P48-B02, E3-P48-B03) were drilled at or near the three TPHC-contaminated locations to total depths of 9 feet BGS. Two split-spoon samples were collected from each boring at depths of 4 to 6 feet BGS and 9 to 11 feet BGS.

3.2.9.7 Nature and Extent of Contamination

Analysis of the groundwater samples collected from the three existing OHM wells showed no volatile organics or petroleum hydrocarbons above screening values. Subsurface soil sampling results indicated the presence of TPHC (66.6 μg/g) in boring E3-P48-B01 at a concentration significantly below the most stringent MCP screening level of 500 μg/g for Level 1 groundwater and soils. TPHC was not detected in any other boring above a concentration of 20 μg/g. A full summary of analytical results is provided in Tables 3-48 and 3-49 following Section 3.2.9.8, Conclusions and Recommendations.

3.2.9.8 Conclusions and Recommendations

All previous sampling performed by OHM and E & E suggests that the subsurface soils and groundwater pathway at Site P48 do not warrant further investigations. Analysis of sampling results show no significant contamination at concentrations above stringent screening values. No further action is recommended for this site.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 3-48
Chemical Summary Report For Groundwater
Site: P48
Units: UGL

	Site ID	OHM-P48-41	OHM-P48-42	OHM-P48-43			
	Field Sample ID	MXP48411	MXP48421	MXP48431			
	Sample Date	08/30/93	08/30/93	08/30/93			
Test	Parameter .						
TPHC	Total Petroleum Hydrocarbons		< 2000	294 J			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 3-49
Chemical Summary Report For Subsurface Soils
Site: P48
Units: UGG

	Site ID	E3-P48-B01	E3-P48-B01	E3-P48-B02	E3-P48-B02	E3-P48-B03	E3-P48-B03
	Field Sample ID	BX480101	BX480102	BX480201	BX480202	BX480301	BX480302
	Sample Date	08/10/93	08/10/93	08/11/93	08/11/93	08/16/93	08/16/93
Test	Parameter Depth	4.0 ft.	9.0 ft.	4.0 ft.	9.0 ft.	4.0 ft.	9.0 ft.
TPHC	Total Petroleum Hydrocarbons	< 20.0	66.6	< 20.0	< 20.0	< 20.0	< 20.0

Source: USAEC IRDMIS Level 3/E & E. 1994

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

4. WATERSHED 3 — LOWER ASSABET RIVER

4.1 WATERSHED DESCRIPTION AND ASSESSMENT

Proposed investigative activities for the sites identified at the Annex were determined through a review of previous activities and findings, and are governed by the established SOW. The objectives of the activities are to determine whether contamination is present in groundwater, surface water, sediment, or surface/subsurface soils at the assigned Phase II sites, and, in the cases where contamination is thought or known to exist, to confirm and better characterize its nature and extent.

To evaluate each site, and to develop a better understanding of the site's impact on the Annex environment, the Annex has been divided into seven distinct watersheds. In this report, general findings of the field effort are summarized for each watershed as a whole. Detailed information about activities undertaken and sampling results are then provided for each site. Conclusions and recommendations are reviewed and discussed in conjunction with the findings of the Phase I investigation conducted by OHM. Data results are presented with each site investigation report. The appendices provide field reports, special studies, and QA/QC results to support the information presented in the text.

The sites discussed in Watershed 3 are listed in Table 4-1 and depicted in Figure 4-1. Summaries of site-specific activities undertaken for Phase II are presented in the "Field Work Performed" sections for each site.

Table 4-1

WATERSHED 3 SITES

Site Number	Site Name	Current Status
A8/P10	Food Burial Area/Confidence Course Dump Area	Site Investigation
P9	Stream Dump Area between Sites A7 and A9	Site Investigation
P57	Former Building S449	Site Investigation

Source: Ecology and Environment, Inc. 1994.

4.1.1 Watershed Location and Description

Watershed 3 is a small area of approximately 175 acres lying between the hills in the north end of the Annex and the Assabet River. One very small, perennial, unnamed stream, approximately 1,400 feet long, between the hill on which the USAF Laboratory sits to the west, and Tuttle Hill to the east, drains all or some parts of the sites investigated; other parts of the watershed discharge directly to the Assabet River. The sites E & E investigated within

this watershed were Sites A8/P10, Site P9, and Site P57. Water levels were measured at Site A7, Site A8, and Site A9 on 13 September and 3 December 1993. Average groundwater elevations presented in the "Physical Characteristics" description of each site are based on both sets of water-level measurements. All measurements are presented in Table 4-2 as groundwater elevations.

Table 4-2

WATERSHED 3 — LOWER ASSABET RIVER GROUNDWATER ELEVATIONS*

Site	Well	Water Levels**	
		09/13/93	12/03/93
A7	EHA2	182.54	185.24
	OHM-A7-8	191.14	197.93
	OHM-A7-9	176.24	177.59
	OHM-A7-10	176.21	177.11
	OHM-A7-12	176.53	178.00
	OHM-A7-13	216.85	225.71
	OHM-A7-45	191.94	195.20
A8	OHM-A8-14	192.22	191.20
	OHM-A8-15	191.17	190.70
A9	OHM-A9-16	192.10	191.49
	OHM-A9-17	184.23	183.85
	OHM-A9-18	184.79	184.13
	OHM-A9-47	188.80	187.36
	OHM-A9-49	192.83	dry
	DM8	182.37	181.51
	DM9A	184.63	183.33
	DM10	188.88	187.39
P57	E3-P57-M01	191.45	191.98

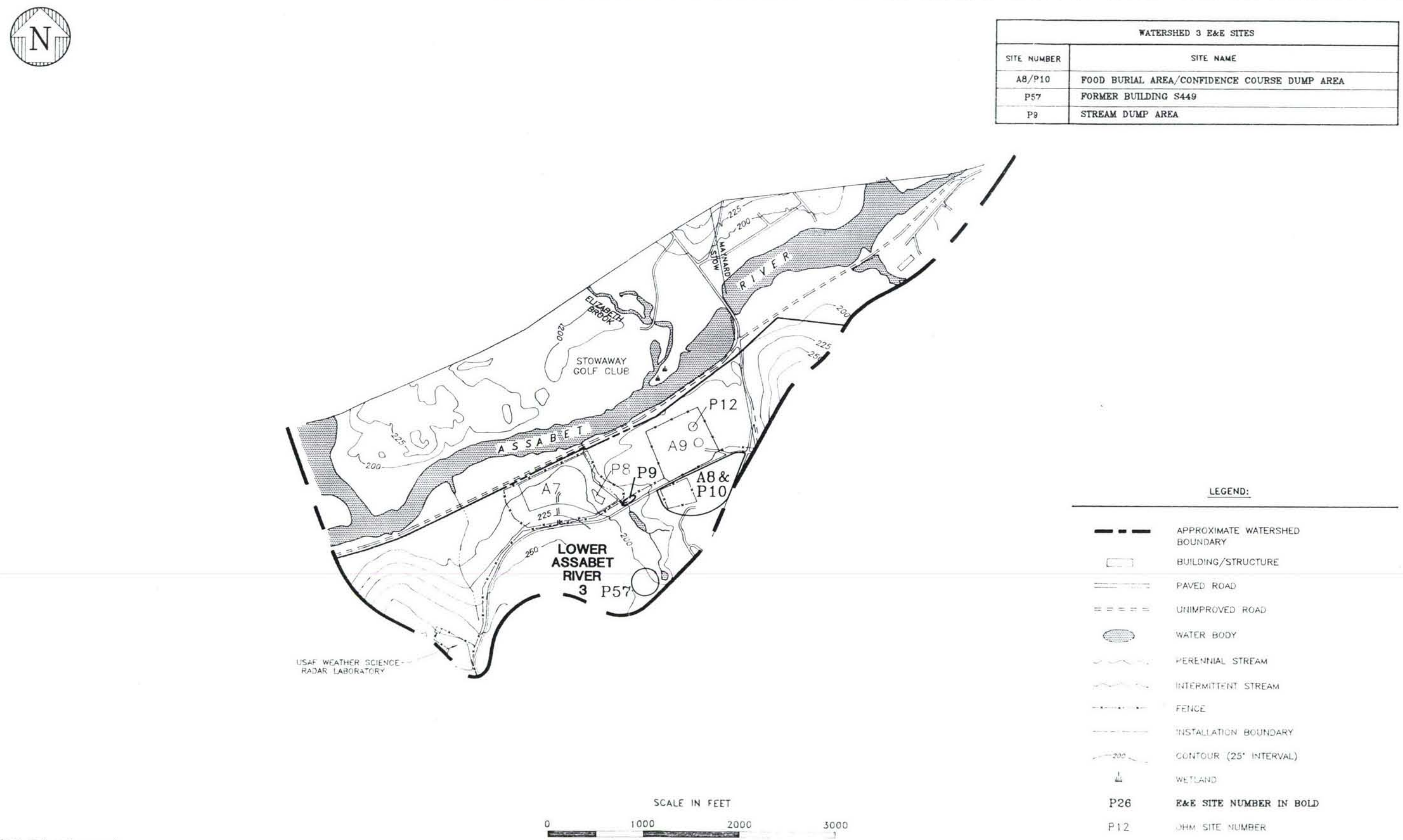
*Includes data collected from OHM, Dames and Moore, E & E, and AEHA wells.
**All measurements are recorded in feet above mean sea level (AMSL).

Source: Ecology and Environment, Inc. 1994.

UC6S035B

SITE NUMBER	SITE NAME
A8/P10	FOOD BURIAL AREA/CONFIDENCE COURSE DUMP AREA
P57	FORMER BUILDING S449
P9	STREAM DUMP AREA

WATERSHED 3 E&E SITES



ecology and environment

Figure 4-1 WATERSHED 3 - LOWER ASSABET RIVER

Although surface water runoff from Site P11 and Site P13 (Watershed 1B) drains into Honey Brook, groundwater drainage from under Site P11 and Site P13 is almost evenly split between Watershed 1B and Watershed 3. This is because of a ridge of lower hydraulic conductivity material (probably till) dividing groundwater flow to the north and the south. Sites P11 and P13 are included in the discussion of Watershed 1B. Throughout Watershed 3, depths both to till and bedrock are shallow on the flanks of the hills and under Site P11 and Site P13. Generally, the sandy overburden thickens towards the river. Groundwater contours parallel the topographic contours, and groundwater discharges to the small unnamed stream and its associated wetland or directly to the Assabet River. Two ponds on Puffer Road at the south foot of Tuttle Hill probably discharge slowly into the groundwater within the watershed's outwash aquifer, but during periods of high runoff, they overflow to a stream draining south to Honey Brook. The overburden aquifer in the watershed is generally thin and of low transmissivity. Wells set in the aquifer yield low quantities of water; however, wells placed immediately adjacent to the river may yield greater water quantities from direct water withdrawal through the bank or bottom of the river.

4.1.2 Preliminary Watershed-Wide Assessment

In order to assess the overall impacts of the Annex on the surrounding environment, a watershed approach has been adopted. This approach divides the facility into areas draining to particular streams of surface water bodies, both by surface runoff (which is minimal at the annex) and by groundwater flow. Within each watershed, the individual sites are potential sources of contaminants and the surface water and sediments are potential receptors or sinks. Movement of water through the Annex and the discharge of groundwater to surface water transports contaminants from the soil to groundwater and then to surface water and sediments. Sediment layers are often organic-rich with high TOC that can adsorb contaminants occurring in groundwater before they reached surface water. Any persistent toxics present in the groundwater discharge can accumulate in sediments and in biota living in the streams and ponds. The result is that the impact of all sites within a given watershed tends to be concentrated in the sediments within the surface water draining the watershed and in surface water itself.

Analysis of results of sediment and surface water sampling at the Annex along a given drainage may lead to findings of where discharges from specific sites enter the surface water pathways. Samples taken at the point where drainages leave the Annex or join a larger stream allow an assessment to be made of the cumulative impact of a particular watershed. Sampling results were compared to background pond and stream levels and also to preliminary screening values. Surface water screening values include water quality criteria regarding both human health and aquatic life, while sediment screening values are ecologically-oriented. Surface water and sediment sampling results were also compared to site-specific groundwater and soil sampling results to attempt to identify potential sources of watershed contamination. Sampling results from previous investigations by Dames and Moore in 1984 and 1985, OHM in 1992 and 1993, and E & E in 1993 and 1994 have all been considered in the watershed assessments. The number of samples used for analysis of particular contaminants will vary depending on the varying analyte spectrum for each sample used in this assessment.

Watershed 3 is entirely located within Annex boundaries. The principal drainage from this watershed is a small stream whose source is a groundwater seep located southwest of Site A8. The groundwater seep receives flow from the northern portions of Sites P11 and P13, as well as the southern and western portions of Sites A8 and P10. The stream itself drains portions of Sites A8 and P10, P57, P9, A7 and A9. Some groundwater discharge and surface runoff from Sites A7 and A9 enter into the Assabet directly — impacts through these pathways will not be assessed in this section. Table 4-3 lists the surface water and sediment locations analyzed in the assessment of Watershed 3.

Table 4-3

SURFACE WATER/SEDIMENT SAMPLE LOCATIONS IN WATERSHED 3*

Sample Location ID	Location
	Tributary to Assabet River
E3-P11-D04	Groundwater seep southwest of Sites A8/P10, source of tributary to Assabet
E3-P57-D01	Drainage from small wetland east of Site P57
P9SD3/SW3 SW/SED7	Tributary to Assabet, at northwest end of small pond south of Patrol Road.
P9SD2/SW2 P9SD4/SW4	Tributary to Assabet in small wetland at Site P9, north of Patrol Road
P9SD1/SW1	Tributary to Assabet, downstream of Site P9
A7SD1/SW1 A7SD2/SW2	Tributary to Assabet, downstream of Sites A7/P8 and Site P9
SW/SED8 E3-BCK-D03	Tributary to Assabet, downstream of Sites A7/P8, and Site P9, just upstream of entry into Assabet
	Assabet River
FW1SD14/SW14	Assabet River upstream of Watershed 3 at Crow Island
FW1SD15/SW15	Assabet River at entry point of tributary from Sites A7/P8 and Site P9

*From upstream to downstream.

Source: Ecology and Environment, Inc. 1994.

4.1.2.1 Water Quality Parameters and Sediment Conditions

Water quality parameters were only measured at the surface water sample point taken just upstream of the outlet of the tributary to the Assabet River at Track Road. At this point, the pH reading was 7.90, and the turbidity was relatively low (22.00 NTUs) at the time of the sampling (September 17, 1993). TOC content of sediments in the stream draining Watershed 3, were relatively low, ranging from 3,980 μg/g (0.44 percent) to 16,600 μg/g

(1.66 percent), with the exception of the sediments immediately downstream of the wetland northeast of Site P57, where the sediments had a much higher organic carbon content (234,000 μg/g or 23.4 percent). Sediments in the Assabet River (at sample point FW1SD15) at the outlet from the tributary were also high in organic carbon content (368,000 μg/g or 36.8 percent).

4.1.2.2 Sampling Results in the Tributary to Assabet River

At the Groundwater Seep

A groundwater seep, located south of Site A8/P10 and west of Sites P11 and P13, receives drainage from portions of these sites, and was sampled as part of investigations at the Annex. The sample point (E3-P11-D04) was downgradient of the seep itself, which is located in a hillside that also contains some metal debris and other dumped material.

In the surface water sample (E3-P11-D04) taken from the groundwater seep, in December 1993, mercury was found at 0.244 μg/L, which is above the surface water screening value of 0.14 μg/L (MA/CWA WQC for consumption of water and fish), the WQC for fish consumption alone of 0.15 μg/L and the MA/CWA WQC for protection of aquatic life of 0.012 μg/L. The mercury result was below the SDWA MCL for drinking water of 2 μg/L. The seep was barely flowing at the time of sampling with less than six inches of water, and the water sample was brown in color, indicating highly turbid conditions with a high level of suspended solids present. No mercury was found elsewhere in surface water in this watershed, although mercury was found in sediment at the sample below Site P57. No mercury was detected in groundwater sampling conducted at Sites P11/P13 or at Sites A8/P10, indicating that this detection is probably unrelated to these sites. Similarly, several other metals (arsenic, lead, copper, cadmium, and nickel), were found in the surface water at concentrations above screening values.

The detailed contours of groundwater elevations incorporating data from Sites A7, A8, A9, A10, P11, P13, and P57 clearly show that the perennial stream north of White Pond Road and its associated wetlands are groundwater discharge points from both east and west (see Plate 3, the 190-foot contour). Because of the configuration of the water table it is clear that the spring and its adjoining wetlands captures groundwater from at least part of Site P8, part of Sites P13 and P11, and all of Site P57. The spring itself, depending on its average rate of flow, may only intercept flow from part of Site P13 and the area north of White Pond Road between Site P13 and the spring. If this area is approximately 300 feet wide and 800 feet long, and infiltration is equivalent to 22 inches per year, the average groundwater discharge would be approximately six gallons per minute or 9,000 gallons per day. This is in accord with field observation.

Because of this low flow and the highly organic and fine-grained nature of the sediments at the spring, there is no area of flowing water with a clean sandy bottom where sample containers can be submerged without the sample becoming turbid with suspended solids. The relatively high levels of metals in the sample collected on 1 December 1993 is confirmed to be the result of suspended solids by comparison with a sample from the same

location taken at a later date (26 April 1994). The results of data of the resampling on 26 April 1994 show that the sample did not have any exceedances of surface water screening levels. The low TSS of 5 μg/L shows that a non-turbid sample of this groundwater at its discharge point to surface water contains no detectable mercury, lead, arsenic, antimony, chromium, cobalt, nickel, or thallium. It shows low levels of silver (2.31 μg/L), barium (7.85 μg/L), beryllium (0.268 μg/L), copper (4.03 μg/L), vanadium (2.84 μg/L), and zinc (4.98 μg/L), none of which exceed any regulatory level. The original data with the elevated levels of metals collected in December 1993 is not included in Table 4-4 since it does not represent surface water quality.

Clays, slits, and organic matter are all typically higher in metals content than sands or coarser sediments. Surface water samples made turbid by sediment will almost always show elevated metals. If the parent materials contain metals, which is the case for the glacial sediments, the origin materials are the metamorphic and igneous bedrock of New England and Canada. In addition, there is a pile of trash including metal on the bank above the spring.

In the sediment sample taken at the groundwater seep, arsenic (11.6 μg/g), nickel (26.0 μg/g) and silver (1.89 μg/g) were found above background and screening levels. These concentrations are well below NOAA ERM levels. These metals were not elevated in groundwater or soil samples at Sites P11/P13 or Sites A8/P10, and their detection at the seep may reflect naturally occurring levels of arsenic, nickel and silver or may be related to the debris in the hillside near the seep. No pesticides were detected in the sediment sample taken at the groundwater seep. TPHCs were detected at 106 μg/g, which is above the lowest effect level for TPHC used for screening of 2 μg/g (Ontario MOE LEL). In the April 1994 resampling of the seep, the only metal found in sediments above screening levels was lead (at 33.0 μg/g). TPHCs were not detected in the April 1994 sediment sample.

Below Site P57

A surface water sample could not be taken in the September, 1993 sampling round at the drainage below Site P57 due to a lack of water. The wetland above the drainage did not have standing water at the time. A sediment sample was taken in the drainage path from the wetland. Analysis of this sample indicated concentrations of beryllium, cadmium, lead, and mercury above background and screening levels. No sediment screening value could be found for beryllium, which was found at 0.893 μg/g, above the soil screening value of 0.4 μg/g (MCP GW-1/S-1), but this level only just exceeds the background soil level and is probably natural. Cadmium (1.35 μg/g) was found which is above the screening value of 0.6 μg/g (Ontario MOE LEL) but below the NOAA ERL of 5 μg/g. Lead (75.0 μg/g) was above the screening value of 31 μg/g (Ontario MOE LEL) but below the NOAA ERM level of 110 μg/g. Mercury was found at 0.228 μg/g (estimated), which is slightly above the NOAA ERL (0.15 μg/g), but below the NOAA ERM (1.3 μg/g).

Several PAHs were also found in this sediment sample at levels below the screening value, although no sediment screening value could be located for benzo(*b*)fluoranthene, which was found at 0.140 μg/g. This concentration is well below the soil screening value of 0.7 μg/g (MCP GW-1/S-1). Several pesticides, including dieldrin (0.013 μg/g), DDT (0.016

μg/g), and DDE (0.080 μg/g) were found at trace levels that were above the screening levels, but were below NYSDEC and EPA sediment quality criteria adjusted for the TOC content of the sediment sample (234,000 μg/g or 23.4 percent). One concern at Site P57 was that alleged insecticide research activities at Building S449 may have resulted in a release of pesticides to surrounding media. Some of these pesticides found in sediment were found in soil samples at Site P57, but none of the pesticides in soils were found at concentrations above soil screening levels that might indicate a spill of pesticides. The source of these pesticides is probably not site-related but reflects general past pest management practices at the Annex.

Upstream of Site P9, South of Patrol Road

Two surface water and sediment samples (SW/SED7 and P9SD/SW3) were taken in the area upstream of Site P9 below a small, artificial pond south of Patrol Road. No contaminants were found in surface water samples at this point. In the sediment samples, arsenic (20.0 μg/g in SED7) was found in one of the samples at a concentration above background and screening levels. DDT, and its degradation products DDD and DDE (all 0.018 μg/g), and α-chlordane (0.042 μg/g) and γ-chlordane (0.065 μg/g) were found above screening levels in one of these samples (P9SD3). The other sample was not analyzed for pesticides. The levels of DDD and DDE in the upstream sample taken below Site P57 were slightly higher than those found downstream at sample P9SD3, but the level of DDT was the same, and the concentrations of α-chlordane and γ-chlordane were higher at the downstream sample. These results are consistent with the source of the pesticides being general pest management practices rather than being site-related.

Cyclonite (RDX) (2.0 μg/g) was found in sample SED7 but not at any other points in surface water or sediment in this watershed. RDX (4.72 μg/g) was only found in one other sample in Watershed 3, a soil sample from test pit A7TPB in Site A7, which is downgradient from the SED7 sample point.

At and Below Site P9

Two surface water (P9SW2 and P9SW4) and sediment (P9SD2 and P9SD4) samples were taken in the tributary to the Assabet River as it passes through Site P9 and one surface water (P9SW1) and sediment (P9SD1) sample was taken further downstream of Site P9. In surface soil samples at Site P9, three out of four samples contained high concentrations of arsenic ranging from 220 μg/g to 1,100 μg/g (which was the second highest detection of arsenic in soils to date at the Annex). At Site A9, arsenic (up to 70 μg/g) was also found at concentrations above screening levels in soil samples collected at points below a culvert that formerly drained the bermed area at Site A9 and are upgradient of Site P9. No contaminants were found in surface water samples taken at and immediately downstream of Site P9 above background and screening levels. In sediment samples, arsenic was found in one sample at Site P9 (10 μg/g) and in the downstream sample (11 μg/g) at concentrations above background and the screening level of 6 μg/g (Ontario MOE LEL). The only other compounds found above background and screening levels were several pesticides including DDT, DDD, and α-and γ-chlordane in one sample (P9SD2) at Site P9. The concentrations

of these pesticides is slightly lower than those in the upstream sediment sample taken south of Patrol Road (P9SD3).

Below Site A7

One of two surface water samples taken in the tributary to the Assabet River below Site A7 (further downstream from Site P9) contained arsenic (9.44 μg/L at A7SW2) above background and screening levels. This same sample also contained lead (5.31 μg/L) above the screening level of 3.2 μg/L (MA/CWA WQC for protection of aquatic life), but below the highest level found in background streams of 10.3 μg/L. In sediment samples taken below Site A7, arsenic (14 μg/g at A7SD12 and 12 μg/g at A7SD2) was above background and screening levels. Copper (17 μg/g), manganese (1,900 μg/g), and nickel (25.7 μg/g) were also found in sediments downstream of A7 above background and screening levels. Copper, manganese, and nickel were only found above screening levels at this point on the tributary to the Assabet.

At Track Road

Two surface water and sediment samples (E3–BCK–D03 and SW/SED8) were collected just upstream of the outlet of the small stream that drains Watershed 3 into the Assabet River. Arsenic (1.52 μg/L) was found in one of the surface water samples (E3–BCK–D03) at a concentration above the screening level but below the background level of 3.15 μg/L. Arsenic concentrations in the two sediment samples varied considerably. One of the sample (at E3-BCK-D03) had arsenic (2.95 μg/g) only slightly above background and below the screening level, while the second sample (SED8) contained a much higher concentration (30.0 μg/g). These samples were taken nine years apart with the higher concentration being found in 1984, and the lower found in 1993 sampling. The only other compounds found in sediments above background and screening levels were the pesticides at E3-BCK-D03, DDE (0.038 μg/g), and DDT (0.003 μg/g). Several PAHs were also found in the SED8 sample, but were below screening levels, and probably reflect passing automobile traffic or road runoff from Track Road. TPHC (16.7 μg/g) were also found in the E3-BCK-D03 sample, probably also due to passing automobile traffic and road runoff. The surface water and sediment data from sampling at E3-BCK-D03 are presented after Section 4.1.3, in Tables 4–6 and 4–7, as they are not presented elsewhere in this report.

In the Assabet River at the Outlet from Watershed 3

No contaminants were found in a surface water (FW1SW15) sample taken in the Assabet River at the outlet of the small tributary that drains much of Watershed 3. In the sediment samples taken at this point (at FW1SD15) at depths up to 3 feet, arsenic (140 μg/g) was found but was also found (88 μg/g) in a sediment sample (FW1SD14) taken upstream at Crow Island above any outlets from the Annex. This may indicate that the source of the arsenic found in sediments at the outlet of the stream from Watershed 3 may actually be upstream in the Assabet River itself, rather than from the high concentrations of arsenic found in soils at Site A9 and Site P9. The relatively high organic carbon content of sediments in the Assabet at this point (368,000 μg/g or 36.8 percent) relative to the upstream sample in the

Assabet and to the upstream samples in Watershed 3 drainage, would indicate that these sediments could absorb and concentrate contaminants coming from either source. Sediment samples at this point also contained PCE (at 0.016 μg/g), toluene (0.019 μg/g), DDT (0.0763 μg/g), DDD (0.254 μg/g), DDE (0.112 μg/g), α–chlordane (0.126 μg/g), γ-chlordane (0.23 μg/g), Arochlor 1254 (0.49 μg/g), and zinc (248 μg/g), all of which have also been found at elevated levels at Site A7. These contaminants were not found in the upstream Assabet River sediment sample (FW1SD14), with the exception of zinc which was found at much lower levels. The pesticides were found in upstream samples in the Watershed 3 drainage, but at lower levels. The concentrations of arsenic, zinc and several other metals, the pesticides, and Arochlor 1254 found at sediment sample FW1SD15 were above background and screening levels. Only arsenic, the pesticides, and Arochlor 1254 were at concentrations above the NOAA ERM levels. When compared to NYSDEC and EPA sediment quality criteria that were adjusted for the organic carbon content of the sediments at this point, only Arochlor 1254, and α- and γ-chlordane were found above the criteria.

4.1.2.3 Summary of Watershed Assessment

Surface water in the tributary to the Assabet River that drains much of Watershed 3 is relatively free of contaminants. A summary of the detections in surface water above preliminary screening levels is provided in Table 4–4 at the end of this summary. Arsenic was found in one surface water sample (A7SW2) above both background and screening levels, and may be related to arsenic found in soils at Site A9 and Site P9, and in sediments at several points in the drainage to the Assabet. Mercury was found in a surface water sample at the groundwater seep, but is thought to be the result of high levels of suspended solids.

In sediments, the key concern in this watershed is arsenic which was found in concentrations above background and screening levels in more than half the sediment samples taken. A summary of the detections in sediments above preliminary screening levels is provided in Table 4-5. The pattern of arsenic concentrations may indicate some accumulation of arsenic in sediments in the tributary to the Assabet, but the exact source is unknown. Arsenic was found in soils at Site A9 and Site P9 at relatively high concentrations above background and screening levels. The concentration of arsenic (140 μg/g) found in sediments in the Assabet River below the outlet of the Watershed 3 drainage may be related to the arsenic found at Site P9 and Site A7, but given that arsenic (88 μg/g) was also found in sediments upstream at Crow Island in the Assabet, the source of the arsenic may also be found upstream in the river itself. The relatively high organic carbon content of the sediments at the outlet from Sites A7/P9/A9 area would increase the likelihood of contaminants absorbing into sediments at this point from Assabet River sources or sources in Watershed 3. The only other contaminants found frequently in the Watershed 3 drainage were several pesticides at relatively low levels that are probably the result of past pest management practices at the Annex.

Table 4-4

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SURFACE WATERS IN WATERSHED 3 (μg/L)

Compound	Max. Background	Screen Level	Source	Highest Concentration	Sample Location ID	Locations were found Above Background and Screen Level	Frequency Above Screen and Background Level
Arsenic	3.15	0.018	MA/CWA WQC[1]	9.44	A7SW2	Below Site A7	1/7
Lead	10.3	3.2	MA/CWA WQC[2]	5.31	A7SW2	Below Site A7	0/9 1/9 (above screen only)
Manganese	156	---	--	261	A7SW2	Below Site A7	1/7

Note: Surface water samples taken in the Assabet River are not included in this table. Surface water samples taken at the groundwater seep are not included, as the results are thought to be due to suspended solids in the sample rather than indicative of actual conditions in the surface water.

[1]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for protection of human health regarding consumption of water and fish.
[2]MA/CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for protection of aquatic life.

Source: Ecology and Environment, Inc. 1994.

Several metals, pesticides, PCE, and one PCB, Arochlor 1254 were also found in the sediment sample taken in the Assabet at the outlet of the drainage from Watershed 3. Many of these compounds were also found at Site A7. These contaminants were not found at an upstream sediment sample in the Assabet taken near Crow Island, with the exception of zinc which was found at much lower levels. The sediments in the Assabet at the outlet from Watershed 3 had a much higher organic carbon content than the upstream sample meaning that it is more likely that contaminants flowing downstream in the Assabet would more readily absorb into these organic-rich sediments. This phenomena would also apply to any contaminants flowing down the stream that drains Watershed 3. The analytical data for Watershed 3 is provided in Tables 4-6 and 4-7 at the end of this discussion on pages 4-19 and 4-20, respectively.

Concerns regarding Site A7 and Site A9 are being addressed through the Remedial Investigation/Feasibility Studies (RI/FSs) currently being conducted at these sites. Further investigation is recommended regarding the arsenic concentrations found in soils at Site P9, including an assessment whether there is any connection between the arsenic found in soil samples at the southwest corner of Site A9 and those found at Site P9.

Table 4-5

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SEDIMENT IN WATERSHED 3 (µg/g)

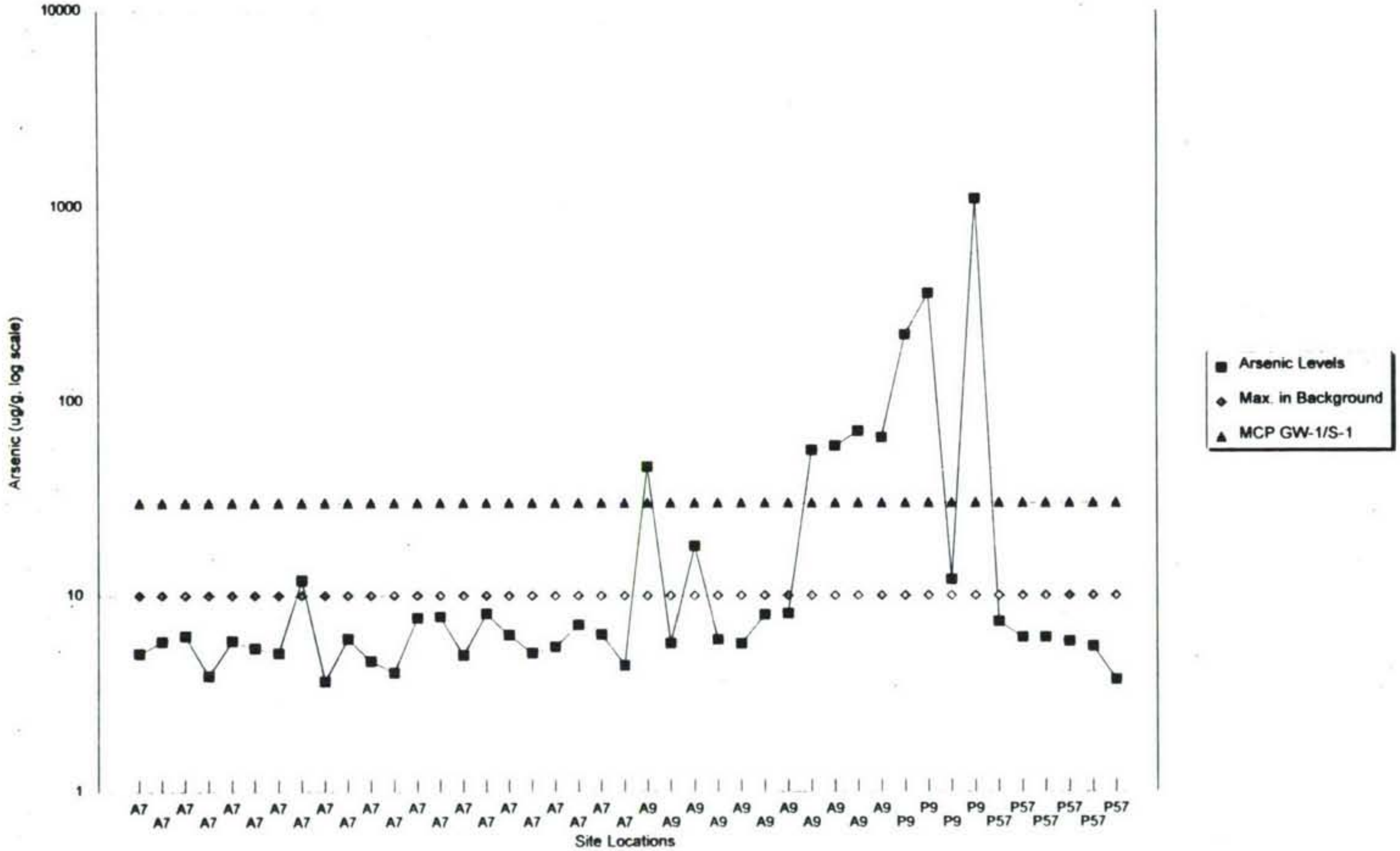
Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Sample Location ID	Above Background and Screening Level	
						Locations Found	Frequency
Arsenic	2.03	6	Ontario MOE LEL[1]	30	SED8	At seep above Site P9, Site P9, Below Site P9, Below Site A7	7/11
Beryllium	0.18	0.4	MCP GW-1/S-1 soil value[2]	0.893(L)[4]	E3-P57-D01	Below Site P57, At Track Road	1/8
Cadmium	0.357	0.6	Ontario MOE LEL	1.35	E3-P57-D01	Below Site P57, At Track Road	1/8
Copper	6.33	16	Ontario MOE LEL	17	A7SD2	Below Site A7	1/8
Lead	4.48	31	Ontario MOE LEL	75.0	E3-P57-D01	Below Site P57, at seep	2/11
Manganese	70.5	460	Ontario MOE LEL	1,900	A7SD2	Below Site A7	1/8
Mercury	---	0.15	NOAA ERL[3]	0.228(J)[5]	E3-P57-D01	Below Site P57	1/8
Nickel	5.92	16	Ontario MOE LEL	25.7	A7SD2	Below Site A7, at seep	2/9
Silver	---	0.5	Ontario MOE LEL	1.89	E3-P11-D04	At groundwater seep	1/9
α-Chlordane	---	0.0005	NOAA ERL (for Chlordane)	0.13	P9SD2	Above Site P9, At Site P9	2/9
γ-Chlordane	---	100.00		0.23	P9SD2	Above Site P9, At Site P9	2/9
Dieldrin	---	0.00002	NOAA ERL	0.013	E3-P57-D01	Below Site P57	1/9
Endrin	---	0.00002	NOAA ERL	0.016	E3-P57-D01	Below Site P57	1/9
DDD	---	0.002	NOAA ERL	0.021	P9SD3	Above Site P9, At Site P9	2/9
DDE	0.0015	0.002	NOAA ERL	0.080	E3-P57-D01	Below Site P57, Above Site P9, At Track Road	3/9
DDT	---	0.001	NOAA ERL	0.018	P9SD3	Above Site P9, At Site P9, At Track Road	3/9
TPHC	16.6	2	Ontario MOE LEL	106	E3-P57-D04	At seep SW of Site A8, At Track Road	2/2

Note: Surface water samples taken in the Assabet River are not included in this table.

[1]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[2]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[3]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range Low.
[4] L = Result biased low.
[5] J = Value is estimated.

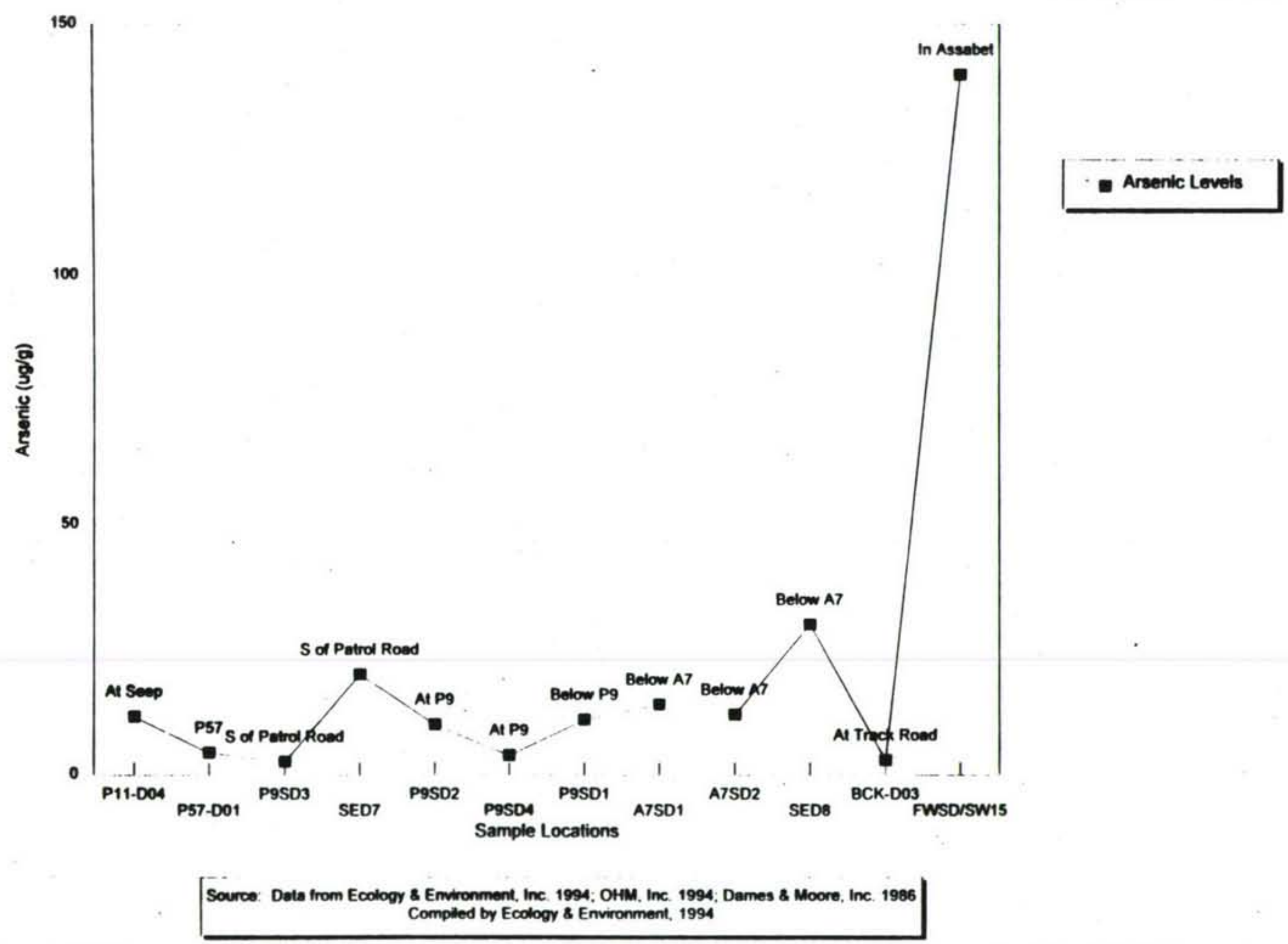
Source: Ecology and Environment, Inc. 1994.

Graph 4-1 shows a profile of arsenic concentrations found in soil samples in Watershed 3. Graph 4-2 shows a profile of arsenic concentrations in the tributary to the Assabet that drains Watershed 3.



Source: Data from Ecology & Environment, Inc., 1994, OHM, Inc., 1994
Compiled by Ecology & Environment, Inc., 1994

Graph 4-1 Arsenic Concentrations in Soils at Sites in Watershed 3



Graph 4-2 Arsenic Concentrations in Sediments in Tributary to Assabet River

4.1.3 QA/QC Program Analysis of Results for Watershed 3

This section provides a summary of the results of the QA/QC review performed using the protocol described in Volume I, Section 5.3.3.

Data for Watershed 3 were evaluated for usability by reviewing laboratory and field QC sample data for contamination possibly introduced into field samples by either sampling or analysis procedures. First, method blanks were reviewed for each analyte in the 98 lots associated with Watershed 3, followed by trip blanks and then rinsate blanks. Following consideration of laboratory and field QC blank samples data, laboratory flagging codes and USAEC data qualifiers were evaluated with laboratory control charts for each lot and sampled for quality assurance problems. Analytical results were then reviewed for precision through consideration of the RPD between each sample/duplicate pair and MS/MSD sample set.

Following is a discussion of samples for each site affected by QA/QC evaluation. Samples with contamination also found in the blank were qualified either with a "B" usability code for "present in the blank" or a "K" usability code for a result-biased high. Samples considered to have quality assurance problems were qualified with either an "L" usability code for a result-biased low or "R" for rejected. Samples exhibiting either high or low recoveries were qualified with a "J" usability code for estimated or "R" for rejected. Appendix F provides a list of all QC summary data for method blanks, trip blanks, rinsate blanks, field duplicate samples, and MS/MSD samples.

4.1.3.1 Site A8/P10 — Food Burial Area / Confidence Course

Blank contamination was observed for eighteen analytes in seven samples. The analytes of concern were: α-BHC, α-endosulfan, aldrin, beryllium, delta-BHC, dieldrin, endrin, endosulfan sulfate, γ-chlordane, lindane, DDD, DDE, heptachlor, and methylene chloride which were found in method blanks and acetone, heptachlor, sodium, and lead which were found in rinsate blanks. In all cases the compounds were found in the blank samples due to laboratory equipment carryover, common laboratory contamination or the rinsate source water. The only analyte which was found in trip blanks was acetone, a common laboratory contaminant.

In addition to these analytes for which sample data were qualified as in the blank, acetone, sodium, lead, and DDE were also found in either the method blank or the rinsate blank at sufficient concentrations so that samples EXA08011, EXA08012, EXA08021, and EXA08022 may have been biased high for these analytes. As a result, these samples were qualified as biased high for these analytes.

Aluminum was the only analyte for which duplicate precision criteria was exceeded. As a result, samples MX0501X1, MXA05061, MXA05241, and MXA05441 were qualified as estimated for aluminum.

Laboratory control charts indicated one notable item: heptachlor was determined to be biased low for one sample (MXA08151).

There were no circumstances for which precision issues based on QA/QC samples (duplicates or MS/MSDs) indicated data that required qualification.

Site A9, associated with Site A8, was free of QA/QC issues except that manganese was found above blank comparison levels in the method blank and was qualified as biased high in sample MXA09161, and beryllium was biased high in sample MXA09471.

4.1.3.2 Site P9 — Stream Dump Area Between Site A7 and Site A9

There were five samples (SDP09011, SXP09011, SXP09021, SXP09031, and SXP09041) for which analyte data was qualified based on blank contamination. Acetone, aldrin, bis(2-ethylhexyl)phthalate, and endosulfan sulfate were all found in the method blanks and acetone, cadmium, heptachlor, and sodium were found in rinsate blanks.

In addition, there were three samples (SDP09011, SXP09021, and SXP09031) for which sodium was biased high based on the sodium concentration found in the rinsate blank.

A review of the duplicate pair (SXP09011/SDP09011) associated with Site P9, resulted in the qualification of these two samples as estimated for α-chlordane, benzo(*a*)anthracene, endrin, and γ-chlordane.

There were no other QA/QC issues associated with Site P9.

4.1.3.3 Site P57 — Former Building S449

Analytes found in QC method blank samples associated with samples from Site P57 include: α–BHC, α-endosulfan, aldrin, and lindane from laboratory equipment carryover, and bis(2-ethylhexyl) phthalate and methylene chloride from common laboratory contamination. Analytes found in the rinsate blank samples include aluminum, cadmium, methylene chloride, sodium, antimony, and zinc from either laboratory contamination or particulates smaller than the 0.45 micron filter used for filtering. In all cases, data were qualified as found in the blank.

Aldrin, cadmium, potassium, sodium, and zinc were found in either the method blank or the rinsate blank in concentrations higher than the blank comparison level. As a result, nine samples were biased high for one or more of these analytes.

On the basis of laboratory control charts for each lot, lot AASP was qualified as biased low because multiple surrogates were below the lower control limit. This affected many of the BNAs found in soil samples at Site P57.

On review of the duplicate pair precision data associated with Site P57 (SXP57011/SDP57011), anthracene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene,

indeno(1,2,3-cd)pyrene, DDE, and DDT were found to be outside of RPD control limits. As a result these samples were qualified as estimated.

As a result of low recoveries in the MS/MSD samples associated with Site P57, α–chlordane, lead, antimony, and selenium in sample DXP57011 was qualified as estimated. DDT was also estimated in this sample because of high MS/MSD recoveries. Sample MFP57012 was qualified as estimated for mercury because of a low matrix spike recovery.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 4-6
Chemical Summary Report For Facility Wide Surface Water Samples
Site: BK3
Units: UGL

Test	Parameter	E3-BCK-D03					
	Field Sample ID	WXBCK031					
	Sample Date	09/17/93					
EXPLOSIVES	1,3-Dinitrobenzene	< 1.00					
TAL METAL	Aluminum	71.3 J					
	Arsenic	1.52 J@					
	Barium	5.56 J					
	Calcium	8760 !					
	Iron	760 J					
	Lead	1.04 J					
	Magnesium	1950 !					
	Manganese	154					
	Potassium	4460 !					
	Sodium	6600					
	Zinc	17.3 J!					
WQP	Phosphorus, Total	25.0 J					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 4-7
Chemical Summary Report For Facility Wide Sediment Samples
Site: BK3
Units: UGG

Test	Parameter						
	Site ID	E3-BCK-D03					
	Field Sample ID	DXBCK031					
	Sample Date	09/17/93					
TAL METAL	Aluminum	3880					
	Arsenic	2.95 !					
	Barium	17.9					
	Beryllium	0.159 JL					
	Calcium	558 J					
	Chromium	8.51					
	Cobalt	4.81 !					
	Copper	13.1 L!					
	Iron	9030 !					
	Lead	18.0 J!					
	Magnesium	1570					
	Manganese	108 !					
	Nickel	7.80 !					
	Potassium	742					
	Thallium	0.088 J					
	Vanadium	11.5					
	Zinc	28.3 J!					
TCL Pest	P,P-DDE	0.038 C#					
	P,P-DDT	0.003 C#					
TOC	Total Organic Carbon	16600					
TPHC	Total Petroleum Hydrocarbons	16.7 J!#					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

4.2 SITE DESCRIPTIONS

4.2.1 Site A8 — Food Burial Area; Site P10 — Confidence Course Area

USAEC identified Site A8 in 1980 through interviews conducted with Natick Laboratory employees, who said the site had been used for burial of waste or excess food (USATHAMA 1980). Fort Devens identified Site P10 in 1990 as one of several possible chemical dumps previously in use at the Annex (Fort Devens 1990). Figure 4-2 is the site map for A8 and P10. Because the two sites share many of the same characteristics, the following discussions often refer to them as one "area," or as A8/P10, except when a feature peculiar to one or the other of them is being described.

4.2.1.1 Site Location

Sites A8 and P10 are adjacent to each other in the northern part of the Annex between Patrol Road and White Pond Road. Approximately 400 feet southwest of the intersection of these two roads lies a cleared area enclosed within a barbed wire fence. A dense pine forest surrounds the clearing. The ground looks substantially disturbed and there are visible traces of excavation. In some parts of Site A8, cloth and paper can be seen emerging from the ground. There is a noticeable odor of sanitary debris at Site A8.

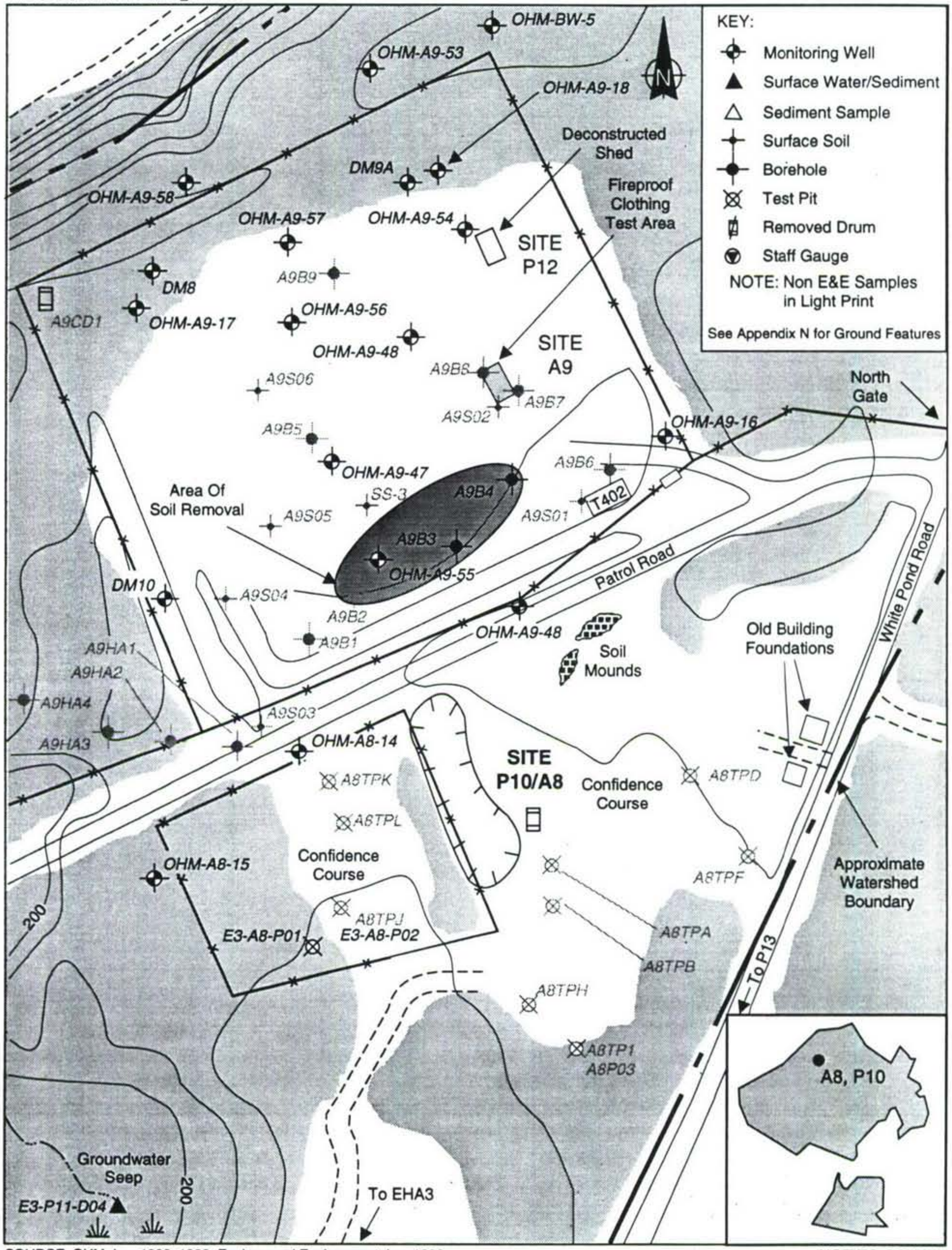
Site P10 (Confidence Course Area) is immediately northeast of Site A8. It is characterized by cleared areas and various wooden structures such as climbing walls, climbing ropes, and logged paths used in obstacle courses. Northeast of Site P10 are several building foundations. On the western edge of Site P10, near the fence enclosing the suspected food burial area in Site A8, there is a large depression. On its eastern side, there is a half-buried, crushed drum. In general, metal debris such as scrap metal, pipes, and cable is scattered randomly throughout Site P10.

4.2.1.2 Physical Characteristics

Site A8 and Site P10 are on an outwash plain of sand and gravel situated between a ground moraine to the southwest, the Assabet River to the northwest, another ground moraine to the northeast, and a drumlin to the east. Surface elevations across the sites range from 205 to 215 feet AMSL. Average groundwater elevations range from 192 to 194 feet AMSL.

Nine test pits were excavated at Site A8 and Site P10 by OHM in 1991. Outwash material consisting of a poorly sorted mixture of sand, silt, and gravel, was encountered over the entire depth of each pit. At some locations, the outwash material was covered by a thin layer of topsoil. None of the test pits were excavated beyond 6 feet BGS. Two exploratory pits excavated by E & E in 1993, near OHM-A8-TPJ, encountered similar outwash material extending to a depth of 8 feet at each location. Two monitoring wells (OHM-A8-14 and OHM-A8-15) were installed by OHM in 1992. Borehole depths at these locations were 24 and 25 feet, respectively. Soil classification logs show poorly sorted outwash material extending through the entire length of each boring.

11: SUDBURY\NFADD\UC6_A8.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 4-2 MAP OF SITE A8 FOOD BURIAL AREA
MAP OF SITE P10 CONFIDENCE COURSE DUMP AREA

Bedrock was not encountered during subsurface explorations at Site A8; however, at OHM-A9-16, approximately 100 feet north of Site A8 and Site P10, bedrock was encountered at 68.5 feet BGS. The bedrock material was identified as Gospel Hill Gneiss (OHM 1992).

An average transmissivity of 30 feet^2 per day was calculated for the two area wells (OHM-A8-14 and OHM-A8-15) based on an average aquifer thickness of 30 feet. This low transmissivity is comparable to that of other wells set in outwash across the facility.

Surface water flows west from the sites to a small stream, which drains northwest into the Assabet River. Water levels and hydrogeologic information collected at Site A8 and Site P10 indicate that groundwater also flows west to the Assabet tributary. It is possible, however, that groundwater from the eastern end of the area flows north beneath Site A9 and discharges directly to the Assabet River.

4.2.1.3 Ecological Characterization

Most of the area encompassing Site A8 and Site P10 is vegetated with grasses and forbs and scattered bushes. The southwestern edge of the area is overgrown by a dense forest of oak and hardwood trees ranging from 40 to 60 feet in height (LFS 1983).

Although some groundwater from the area flows north through Site A9 towards the Assabet River, groundwater generally flows towards an unnamed brook located approximately 1,000 feet west of the area (E & E 1993). On both sides of this unnamed brook, which is hydrologically connected to the Assabet River, there is a seasonally saturated riparian wetland vegetated with deciduous trees (USDOI 1977). Approximately 400 feet northeast of the area there is a vernal pool referred to as North Gate Pool; a second vernal pool, Facility III Corner Pool, lies 400 feet east of the area (Butler 1992). Both vernal pools may be hydrologically connected to this area and could potentially be affected by Sites A8 and P10.

This area provides several different habitats: open area, upland forest, forested wetland, and open water. Areas covered with grasses, forbs, and shrubs provide good habitat for deer, ground-nesting birds, small mammals such as mice, and raptors. Small mammals, songbirds, upland gamebirds, and deer feed on oak acorns, buds, and twigs (Martin *et al.* 1951) and are expected to frequent the southwestern part of the site. Forested wetlands similar to the one northeast of Site A8 and Site P10 provide valuable cover, food, and nesting and roosting areas to many upland, semi-aquatic, and aquatic wildlife. Small, open bodies of water such as the vernal pools and wide, slow-flowing rivers such as the Assabet River provide drinking water, food, breeding areas, and shelter for permanent residents as well as animals that regularly visit from other habitats. Amphibians, reptiles, and waterfowl may all use this habitat. The Assabet River is also expected to sustain several species of piscivorous birds and provide many species with a safe migration corridor.

Eggs from the blue-spotted salamander (*Ambystoma laterale*), a Massachusetts species of special concern, and spotted salamanders (*Ambystoma maculatum*), a state watch-list species, have been identified in North Gate Pool. Wood frogs and fairy shrimp were also

observed in this pool. Wood frogs, spotted salamanders, and fairy shrimp were also seen in Facility III Corner Pool (Butler 1992). No unique habitats are known in the general vicinity of the Site A8/P10 area (NHESP 1992).

4.2.1.4 Site History

Site A8 was identified by Natick Laboratory employees as the probable area used for burial of food associated with food preservation experiments conducted at Natick Laboratories (USATHAMA 1980). Site P10 is the site of a former confidence course located just northeast and adjacent to Site A8, and was identified as possibly being a chemical dumping location (Fort Devens 1990).

Site A8 includes an area of approximately 1.5 acres across Patrol Road from the POL Burning Area (Site A9). Food was reportedly buried between the burning area (Site A9) and the SigMet Building (possibly Building T402A), along White Pond Road prior to 1966. Foodstuffs reportedly buried at Site A8 fall into two rough classifications: meat products used in irradiation experiments for food preservation at Natick; and field rations and canned goods subject to weather and time exposure to assess durability and effectiveness of packaging material.

Food irradiation experiments were conducted at Natick Laboratories with a cobalt-60 source and a linear accelerator. According to the current director of the Sustainability Directorate at Natick (Interview 1993a), the Cobalt-60 radiation source does not turn irradiated objects into radiation sources themselves. Use of a linear accelerator can result in residual radiation in irradiated objects in certain cases when high-energy levels are used. However, according to the former radiation safety officer at Natick (Interview 1991a), most food irradiation tests involving the linear accelerator were conducted at a 10 MeV level, which would not result in any residual radiation in the food. The former radiation safety officer stated that in cases when a 21 MeV level was used, some very low levels of extremely short-life residual radiation in subject food items could occur. Reportedly, food was not allowed to leave the laboratory area at Natick without approval by the safety officer. Many of the irradiation processes commonly used at Natick in the 1960s are currently federally-accepted food preservation practices used by the food industry.

In an interview, a Natick employee (Interview 1985) indicated that 10 to 15 truckloads of packaged food had been buried in the Site A8 area. The employee noted that the source of the food was the food irradiation experiments and testing of packaging under prolonged exposure. Buried food items included canned food and rations. The employee also noted that some of the food may have been stored for more than 10 years prior to burial. A bunker survey in 1973 indicated that subsistence items from the Food Labs were being stored in Bunkers 302 and 304; and a 1977 survey noted the continued use of these bunkers as well as the storage in Bunker 309 of the food subsistence items from the irradiated food test. These items may be the items reportedly buried at Site A8. A second Natick employee (Interview 1990b) said that foodstuffs had been buried in trenches, but could not positively identify Site A8 as the disposal location.

Site A8 has been identified within a fenced area along Patrol Road. Two rectangular temporary buildings were identified on a 1967 facility map and were also present on maps from 1974 and 1978. No building number was associated with these structures, and no use for them could be identified through file searches.

Site P10, an area adjacent to Patrol Road in the confidence course area, was identified through an interview with a former Natick employee as possibly being a site used for chemical disposal (Fort Devens 1990). The Massachusetts Air National Guard and the 3245th Civil Engineers constructed the confidence course in the Site A8/P10 areas in 1985. One facility map used during the interviews identified the location of chemical disposal as possibly being in a rectangular area northeast of the fenced area at Site A8 along Patrol Road.

Historically, several other buildings have been identified in the Site A8/P10 area that do not appear to be related to food burial or possible chemical disposal. Buildings T411 and T412, along White Pond Road, were used as garages or vehicle sheds in which to store facility engineer vehicles. The concrete foundations of these buildings are still at Site A8, northeast of the confidence course area. Building T464, located approximately in the middle of Site A8, was used as a meteorological station. From 1975 to 1979, the Massachusetts Department of Environmental Health used a wood shed northeast of Building T464 as an air monitoring station. Another building on the site, Building T402A, was located on White Pond Road, opposite Building T404 (in Site P13). Building T402A was constructed in 1952, and, like Building T464, was used by meteorological teams. It was demolished in 1966.

4.2.1.5 Results of Previous Investigations

In 1983, AEHA installed the EHA3 well south of Site A8. This well was sampled for constituents on the primary drinking water standards list and for organic priority pollutants. Nitrogen (3 μg/L) as nitrate and nitrite was reported. No other parameters tested for were detected.

OHM performed an SI in 1992 at Site A8 that included a site reconnaissance, a geophysical study, test pit excavations with subsurface sampling, and monitoring well installation with subsurface soil and groundwater sampling. Two drums, scrap metal, and a dump site were identified during the site reconnaissance. Nine test pits were excavated where anomalies were detected in the geophysical study. No PID or radiological readings above background were noted. Only three of the test pits uncovered significant amounts of debris: test pit A8TPJ contained crushed metal cans and a large green metal object (referred to as a the "green metal box") at a depth of 5 feet. Test pit A8TPK contained a large number of metal food cans, toilet paper, a tent, and some cloth. Excavation at test pit A8TPL was impeded by a large number of metal cans. Subsurface soil samples were taken at each of the test pits.

All samples collected at Site A8, except the test pit grab samples for VOCs, were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, TAL metals, and explosives. In test pit subsurface soil samples, no explosives were found and the

only pesticide detected was the DDT degradation product DDD (0.016 μg/g) in test pit A8TPH. A large number of unknown compounds were found in both the volatile and semivolatile organic analyses, and probably represent a combination of laboratory artifacts and site-related materials from food waste burials. Three PAHs were found in test pit A8TPL: (benzo(*a*)pyrene (0.57 μg/g), benzo(*g,h,i*)perylene (0.3 μg/g), and chrysene (0.24 μg/g)), which are products of incomplete combustion and could be associated with burnt hydrocarbons from kitchen activities or from fuels. Mercury (0.147 μg/g) was also present in A8TPL. The maximum level of mercury (0.449 μg/g) found at Site A8 was in test pit A8TPI. Lead levels were determined to be elevated for subsurface soil, although they would be regarded as normal for surface soil.

Groundwater from well OHM–A8–14 in June 1992 contained a trace of the pesticide heptachlor epoxide (0.016 μg/L) and background concentrations of metals. No pesticides were detected in the October 1992 sampling round. Groundwater from well OHM–A8–15 contained background concentrations of metals and methyl–*n*–butyl ketone (3.1 μg/L). Neither this compound nor any other VOCs were found in the October 1992 sample. The only unusual result for groundwater at well EHA3 was elevated levels of sodium (19,200 μg/L and 27,000 μg/L) in the June and October 1992 sampling rounds, very possibly from road salt spread on White Pond Road.

4.2.1.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of geotechnical samples, were analyzed for TCL organics, TAL metals, and herbicides. Table 4-8 provides a summary of the Phase II sampling effort at Sites A8/P10.

Table 4–8

PHASE II SAMPLING FOR SITE A8/P10 — FOOD BURIAL/CONFIDENCE COURSE AREAS

Sample Type	Samples	Sample date(s)	Sampling Rationale
Groundwater	3	08/30/93 08/31/93	Samples were collected to investigate groundwater quality at the site and the potential for off-site contaminant migration.
Subsurface Soils	4	09/22/93	Samples were collected to investigate subsurface contamination and characterize the nature of two anomalies identified during EM31 geophysical surveys near OHM Test Pit A8TPJ, where a green metal box was previously uncovered. Two samples were collected from each of two tests pits E3-A08-P01 and E3-A08-P02.

Source: Ecology and Environment, Inc. 1994.

Geophysical Investigations

E & E conducted an EM31 reconnaissance survey to locate the green metal object previously identified by OHM in Test Pit A8TPJ. The survey confirmed anomalous readings at two staked locations in the vicinity of A8TPJ. The survey also provided data indicating

that one of the anomalies was a large object approximately six to eight feet long, as opposed to several smaller objects. (The metal box was uncovered during a subsequent test pit excavation by E & E at the location of this anomaly.)

Groundwater Sampling

E & E sampled four monitoring wells (OHM–A8–14, OHM–A8–15, OHM–A9–16 and OHM–A9–47) during the August 1993 groundwater sampling event, to characterize groundwater quality downgradient of the suspected food disposal area.

Monitoring wells OHM-A8–14, OHM-A8–15, and OHM-A9–16 were sampled as specified in the original June 1993, *Technical Plan Addenda*. The Addenda specified that four wells were to be sampled, including OHM-A9-49. However, at the time of sampling, well OHM-A9–49 was dry. A decision was made in the field to sample another downgradient well, OHM–A9–47, which was located further west (downgradient) of OHM-A9–49, near the center of the fenced area encircling Site A9. After laboratory analysis and a review of the sampling history of well OHM-A9–47, the groundwater data obtained from the well was discarded, a decision based on information showing that OHM-A9–47 was in a contaminant plume originating in the POL Burn Area (Site A9). The groundwater data was not specific to Sites A8 or P10; further, any identified contaminants were attributable to Site A9. Hence, the groundwater data E & E used to analyze the nature and extent of contamination at Sites A8 and P10 were from wells OHM–A8–14, OHM–A8–15, and OHM–A9–16.

Surface water and sediment sampling were performed at a groundwater seep south of Site A8 as part of the investigation of Site P11. Well EHA3 was also sampled as part of the field activities for Site P11. These efforts are described in the SI report for Site P11. The results are discussed below, in the section on Nature and Extent of Contamination, because groundwater flow from Site A8 is in the direction of the seep and possibly Well EHA3.

Subsurface Soil Sampling

The objective of the subsurface soil investigation at Site A8 was to locate the green metal box previously found by OHM, open it to ascertain its contents, and take samples from the soils beneath the box to identify any subsurface contamination present.

Two test pit excavations (E3-A08-P02 and E3-A08-P01) were completed at Site A8 at the two locations where followup EM31 surveys identified anomalies in the vicinity of OHM test pit A8TPJ. The "green metal box" was uncovered at excavation E3–A08–P02. The metal box proved to be a storage container for discarded foodstuffs, including syrup, Scottie Tissues, and crackers. The contents of E3-A08-P01 appeared to be similar to those found in the green metal box at E3-A08-P02. Both test pits were sampled just above the top of the containers holding the foodstuffs, approximately 3 feet BGS. Two samples were also collected in each pit, from soils directly below the center of the storage container at an approximate depth of 10 feet BGS. All subsurface sampling was initially conducted in Level "B" personal protective equipment (PPE), because the nature of the subsurface containers was unknown. The work was downgraded to Level "C" PPE after constant monitoring of the

breathing zones with an OVA showed no consistent levels of organic vapors above background. An explosimeter was also used near each excavation to monitor the presence of explosive vapors. The monitoring device showed no lower explosive limits were present in either excavation.

4.2.1.7 Nature and Extent of Contamination

The initial concern regarding Site A8 was that the buried foodstuffs and other material may contain hazardous materials that could migrate from the site into surface or groundwater or pose a direct-contact exposure risk. The initial concern regarding Site P10 was that the alleged chemical disposal may have resulted in the contamination of soil or groundwater with hazardous chemicals. Site investigations at these sites to date have not confirmed the presence of significant concentrations of hazardous substances or the migration of chemicals from the site into surrounding media. However, some anomalous sampling results need to be addressed, in particular the detection of mercury and some low levels of PAHs in previous soil sampling. Table 4-9 provides an overview of detections above preliminary screening levels at Site A8. A summary of analytical results for Site A8 is provided at the end of this site's discussion in Tables 4-10, 4-11, and 4-12 at the end of this section. Table 4-12 lists the two monitoring wells sampled from Site A9 and used in the analysis for this SI.

Table 4-9

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE A8

Medium (Units)	Compound	Maximum Back-ground	Screen Level	Source	Maximum Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum (U)[1]	--	50	MA SMCL[2]	72,000	OHM-A8-15	2/2
	Chromium (U)	--	100	SDWA MCL[3]	158	OHM-A8-15	1/2
	Iron (U)	--	300	MA SMCL	99,000	OHM-A8-15	2/2
	Lead (U)	--	15	MA MCL	20.5	OHM-A8-15	1/2
	Manganese (U)	--	50	MA SMCL	1,200	OHM-A8-15	2/2
	Nickel(U)	--	100	SDWA MCL	135	OHM-A8-15	1/2

[1]U = Unfiltered groundwater sample.
[2]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[3]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
Note: The results of surface water and sediment sampling at the groundwater seep are not included in this table, as they are not thought to be related to Site A8 or Site P10.

Source: Ecology and Environment, Inc. 1994.

E & E's groundwater sampling at Site A8/P10 consisted of sampling the two OHM wells (OHM-A8-14 and OHM-A8-15) downgradient on the northwest and west periphery of Site A8 and sampling well, OHM-A9-16, north-northeast, of the area and also possibly downgradient of Site P10. Analysis of an unfiltered sample from well OHM-A8-15, located west of Site A8, indicated the presence of elevated levels of aluminum, chromium, iron, lead,

manganese, and nickel above groundwater screening values. The levels of aluminum, iron, and manganese were above Massachusetts MCLs. The chromium (158 μg/L) and nickel (135 μg/L) concentrations were above the SDWA MCL for groundwater and nickel (both 100 μg/L). The lead concentration detected in this well (20.5 μg/L) was above the Massachusetts MCL (15 μg/L). The chromium and lead concentrations were well below the MCP GW-3 levels for groundwater not used as drinking water, which are 2,000 μg/L for chromium and 30 μg/L for lead, while the MCP GW-3 level for nickel (80 μg/L) was lower than the SDWA MCL. Aluminum, iron, and nickel were also present in the unfiltered sample from well OHM-A8-14, northwest of Site A8, in concentrations below those in OHM-A8-15, but still above groundwater screening values. No other contaminants were positively detected in E & E sampling of these two wells.

While the concentrations of metals detected in E & E sampling at these two wells are a concern, the metal elevations are almost certainly due to the presence of suspended solids in the sample. Two rounds of filtered samples taken by OHM at these two wells in 1992 did not detect aluminum, chromium, iron, lead, manganese, or nickel in levels above any of the screening values used in this study. These results indicate that the elevated metals detected by E & E are not present in the groundwater in a dissolved form.

Sampling of the OHM-A9-16 well, which receives groundwater drainage from the northwest portion of Site P10, indicated elevated levels of aluminum and iron above the Massachusetts SMCLs in an unfiltered sample. Aluminum and iron were not significantly elevated in previous filtered sampling by OHM of this well in 1992. Bis(2–ethylhexyl) phthalate was also detected at 6.80 μg/L in the sample from OHM-A9-16, which is above the groundwater screening value of 6 μg/L (SDWA MCL). This detection is likely to be a field sampling artifact, and was not detected in previous sampling at this well. No other organic compounds were identified in the sample from this well.

At the Groundwater Seep

Surface water and sediment samples were collected downstream of a groundwater seep, located south of Site A8/P10, as part of the investigation of Site P11 and P13. The complete data for these samples is included in the P11 sections of this report. The sample results at this location (E3-P11-D04) are noted here because some groundwater drainage from the eastern and southern portions of Site A8/P10 may enter surface water at this seep. It is also important to note that there is some metal and glass debris on the hillside where the seep is located.

In the surface water sample (E3-P11-D04) taken from the groundwater seep, in December 1993, mercury was found at 0.244 μg/L, which is above the surface water screening value of 0.14 μg/L (MA/CWA WQC for consumption of water and fish). The mercury result was below the SDWA MCL for drinking water of 2 μg/L. The seep was barely flowing at the time of the December 1993 sampling with less than six inches of water, and the water sample was brown in color, indicating highly turbid conditions with a high level of suspended solids present. No mercury was detected in groundwater sampling conducted at Site P11/P13 or at Site A8/P10, indicating that this detection is probably unrelated to these

sites. Similarly, several other metals (arsenic, lead, copper, cadmium, and nickel), were found in the surface water at concentrations above screening values. These elevated levels are thought to be due to the presence of a large quantity of suspended solids in the water.

The seep was resampled in April 1994 to confirm the hypothesis that the earlier results for surface water were due to high sediment content. In order to obtain a turbid-free sample, a small basin was dug, to allow immersion of surface water sample containers without disturbing stream sediments. Analysis of the April 1994 surface water sample showed much lower metals concentrations, none of which exceeded screening levels.

In the sediment sample taken in December 1993 at the groundwater seep, arsenic (11.6 μg/g), nickel (26.0 μg/g) and silver (1.89 μg/g) were found above background and screening levels. These concentrations are well below NOAA ERM levels. These metals were not elevated in groundwater or soil samples at Site P11/P13 or Site A8/P10, and their detection at the seep may reflect naturally occurring levels of these metals or be related to the metal debris found in the hillside near the seep. No pesticides were detected in the sediment sample taken at the groundwater seep. TPHCs were detected at 106 μg/g, which is above the lowest effect level for TPHC used for screening of 2 μg/g (Ontario MOE LEL). In the April 1994 sediment sample taken at the seep, the only metal that exceeded screening levels was lead (33.0 μg/g). TPHCs were not detected in the April 1994 sample. The lead detection like the earlier arsenic, nickel, and silver detection in sediments could be related to metal debris in the hillside or be naturally occurring.

Two soil samples were taken from each of the two test pits excavated at anomalies detected by targeted geophysical surveys at Site A8. The purpose of the excavations was to locate the "green metal box" identified earlier in test pit A8TPJ by OHM. At the first test pit (E3-A08-P01), numerous metal food cans and a door were uncovered. Several metals including chromium (14.6 μg/g), manganese (98.2 μg/g), potassium (1020 μg/g) and zinc (164 μg/g, estimated) were slightly elevated above background surface soil levels, but were below soil screening values. Trace levels of several pesticides were also present but at levels below soil screening values and below highest levels of these pesticides found in background soil samples. Trace levels of several volatile organics, including 2-butanone (0.046 μg/g), 2-hexanone (0.045 μg/g) and acetone (0.160 μg/g) were also detected. The levels for 2-butanone and acetone are below the MCP GW-1/S-1 soil values of 0.3 μg/g for 2-butanone methyl ethyl ketone (MEK) and 3 μg/g for acetone. No soil screening value could be found for 2-hexanone.

The second test pit excavation (E3-A08-P02) was actually a re-excavation of OHM test pit A8TPJ. The "green metal box" was uncovered and discovered to be a storage container for discarded foodstuffs and containers, similar in type to those found E3-A08-P01. Antimony, manganese and potassium were found at levels slightly elevated above background soils, but below soil screening values. Trace levels of several pesticides were also detected. The only volatile organic compound detected was a trace of acetone (0.034 μg/g, estimated) at the 3-foot level in a concentration well below the soil screening value of 3 μg/g.

4.2.1.8 Conclusions and Recommendations

While some elevated metal concentrations were detected in unfiltered samples taken in wells downgradient from Sites A8 and P10, these metals were not elevated in filtered samples previously taken at these wells, indicating the elevated concentrations are the result of suspended solids. Dissolved metals at concentrations of concern were not detected in previous filtered groundwater samples.

Sampling of a groundwater seep that receives some of the drainage from the sites indicated some low-level presence of metals in one of two surface water samples taken at the seep. The sampling of the wells and the seep effectively brackets the potential groundwater drainage from these sites, and the only concern is the metals detections at the seep. Given that high concentrations of metals were not found in the April 1994 surface water sample at the seep, which was taken from a small excavated basin to ensure a turbid-free sample, the presence of elevated concentrations of metals in surface water at the seep is unlikely. Several metals (arsenic, nickel, and silver in December 1993, and lead in April 1994 samples) were elevated above screening levels in sediment samples at the seep and may be related to the debris in the hillside at the seep, or be naturally occurring.

The metals found in sediment downgradient of the seep were not found in filtered groundwater samples at Site A8/P10 or in concentrations above background in soil sampling by E & E and previously by OHM. Thus, these metals in sediments at E3-P11-D04 are not likely to be related to Site A8/P10.

Surface soil sampling by OHM indicated a low level of mercury in two test pits and several PAH compounds, all at levels below soil screening values used in this study. The PAHs are probably the result of incomplete combustion with burnt hydrocarbons, possibly due to fires at the site. Given that low levels of mercury at the site are only slightly above background and the mercury in surface water at the seep in December 1993 was not confirmed in the surface water sample taken in April 1994, it is likely that the mercury detections in soils and the seep do not represent site-related contamination.

No significant impact from the burial of foodstuffs in Site A8 or the alleged chemical disposal in Site P10 is indicated by sampling, and thus no further action is recommended for these sites.

The concentrations of arsenic, lead, nickel, and silver in sediments below the groundwater seep are unlikely to pose any human health risks as they are all well below the health-based soil screening levels for these compounds which are based on the most conservative soil and groundwater categories (MCP GW-1/S-1). While arsenic, lead, nickel, and silver were found in concentrations above the ecologically-based Ontario MOE LELs, arsenic, lead, and nickel were below the NOAA ERL levels, and probably indicate a low level of ecological risk. Silver (at 1.89 μg/g) was just above the NOAA ERL level. The source of the metals is either the metal debris in the hillside, which is not part of Site A8/P10, or naturally occurring levels of these metals in surrounding soils. The overall likely impact of the metals in the sediments is probably low to none.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 4-10
Chemical Summary Report For Groundwater
Site: A08
Units: UGL

	Site ID	OHM-A8-14	OHM-A8-14	OHM-A8-15	OHM-A8-15		
	Field Sample ID	MXA08141	MXA08141	MXA08151	MXA08151		
	Sample Date	08/27/93	08/31/93	08/27/93	08/30/93		
Test	Parameter .						
TAL METAL	Aluminum		6210 @		72000 @		
	Arsenic		6.41		26.3		
	Barium		52.6		338		
	Beryllium		0.333 BJ		3.63 J		
	Calcium		5180		17400		
	Chromium		13.6		158 @		
	Cobalt		5.72 J		58.7		
	Copper		6.74 J		101		
	Iron		7900 @		99000 @		
	Lead		< 5.00		20.5 @		
	Magnesium		2590		27000		
	Manganese		102 @		1200 @		
	Nickel		10.9		135 @		
	Potassium		2230		16500		
	Sodium		18100		5860		
	Vanadium		11.8		147		
	Zinc		48.2 B		219		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 4-11
Chemical Summary Report For Groundwater
Site: A08
Units: UGL

Test	Site ID	OHM-A9-16	OHM-A9-16	OHM-A9-47	OHM-A9-47		
	Field Sample ID	MXA09161	MXA09161	MXA09471	MXA09471		
	Sample Date	08/27/93	08/30/93	08/27/93	08/30/93		
Test	Parameter .						
TAL METAL	Aluminum		399 @		13000 @		
	Arsenic		1.47 J		16.1		
	Barium		6.73 J		81.1		
	Beryllium		< 5.00		0.700 KJ		
	Calcium		6010		10600		
	Chromium		< 10.0		28.3		
	Cobalt		< 10.0		10.1		
	Copper		5.04 J		17.6		
	Iron		556 @		16000 @		
	Lead		6.18		7.92		
	Magnesium		1780		5010		
	Manganese		10.6 K		294 @		
	Nickel		< 10.0		18.4		
	Potassium		2060		5320		
	Sodium		5600		5600		
	Vanadium		< 10.0		21.6		
	Zinc		140		56.7 B		
TCL BNA	Bis(2-ethylhexyl)phthalate		6.80 J@		< 10.0		
TCL VOA	1,1,1-Trichloroethane		< 5.00		300 @		
	Methylene chloride		< 5.00		30.0 @		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: PIT

Table: 4-12
Chemical Summary Report For Subsurface Soils
Site: A08
Units: UGG

	Site ID	E3-A08-P01	E3-A08-P01	E3-A08-P01	E3-A08-P02	E3-A08-P02	
	Field Sample ID	EXA08011	EXA08012	WDBCK021	EXA08021	EXA08022	
	Sample Date	09/22/93	09/22/93	09/22/93	09/22/93	09/22/93	
Test	Parameter .						
TAL METAL	Aluminum	9030	3810		8420	4700	
	Antimony	0.410 J	0.242 J		0.581 !	1.26 !	
	Arsenic	6.88	4.66		6.92	4.61	
	Barium	24.3	14.7		22.2	16.8	
	Beryllium	0.370 J	0.104 J		0.381 J	0.137 J	
	Cadmium	0.330 J	0.191 J		0.488 J	< 0.500	
	Calcium	262 J	505 J		375 J	494 J	
	Chromium	14.6 !	9.19		12.4	9.74	
	Cobalt	5.76	3.80		5.35	4.13	
	Copper	8.09	5.05		9.57	7.20	
	Iron	9940	8380		9840	8690	
	Lead	9.26 K	2.66 B		9.41 K	4.83 B	
	Magnesium	1970	1720		1610	1730	
	Manganese	98.2 !	71.6		105 !	9.67	
	Nickel	9.84	9.47		9.47	7.92	
	Potassium	840 !	1020 !		625 !	928 !	
	Sodium	164 KJ	58.4 BJ		56.4 BJ	79.6 BJ	
	Vanadium	17.7	11.5		16.3	11.5	
	Zinc	19.0 K	18.5 K		20.7 K	17.0 K	
TCL Pest	Endrin Aldehyde	0.007 C	0.006 C		< 0.002	0.002 JC	
	P,P-DDE	0.005 KC	0.001 BJC		0.004 BC	0.002 BJC	
	P,P-DDT	0.006 C	< 0.002		0.003 U	0.001 JU	
	beta-BHC	< 0.002	< 0.002		< 0.002	0.001 JC	
TCL VOA	2-Butanone	< 0.010	0.046		< 0.010	< 0.010	
	2-Hexanone	< 0.010	0.045		< 0.010	< 0.010	
	Acetone	0.036 BJ	0.160 K		0.034 BJ	< 0.100	
	Toluene	0.008	< 0.005		< 0.005	< 0.005	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column. U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

4.2.2 Site P9 — Stream Dump Area Between A7 and A9

Site P9 was identified through interviews with Natick employees as a possible chemical waste disposal dump area (Fort Devens 1990). Figure 4-3 provides a site map.

4.2.2.1 Site Location

Site P9 is near the northern border of the installation boundary, between Site A7 and Site A9 along Patrol Road. The site contains a suspected roadside dumping area on the north side of the intersection of Patrol Road and a southeast-to-northwest-flowing brook. The brook flows underneath a bridge on Patrol Road and continues northwest to the Assabet River about 800 feet to the north. At the time of a site survey in the fall of 1993, stream flow on both sides of the road was almost imperceptible and the water appeared to be nearly stagnant.

4.2.2.2 Physical Characteristics

Site P9 straddles a small, unnamed tributary of the Assabet River. Recent alluvium covering the area is underlain by outwash sand and gravel. The surface elevation at Site P9 is approximately 190 feet AMSL. No wells were installed at Site P9; however, groundwater discharges to the stream crossing through the site, so groundwater depths must be very shallow (less than two feet BGS). This is evident from the fact that the stream must be gaining from the groundwater. It originates from a discharge of groundwater (a spring), and hydraulic heads in the groundwater both to east (Site A8) and to west (Site A7), of Site P9 are higher than the surface water (approximately 187 feet AMSL). Typically in a humid climate where precipitation exceeds evaporation, the streams are perennial and gaining, and there is no reason to suppose that this stream is an exception.

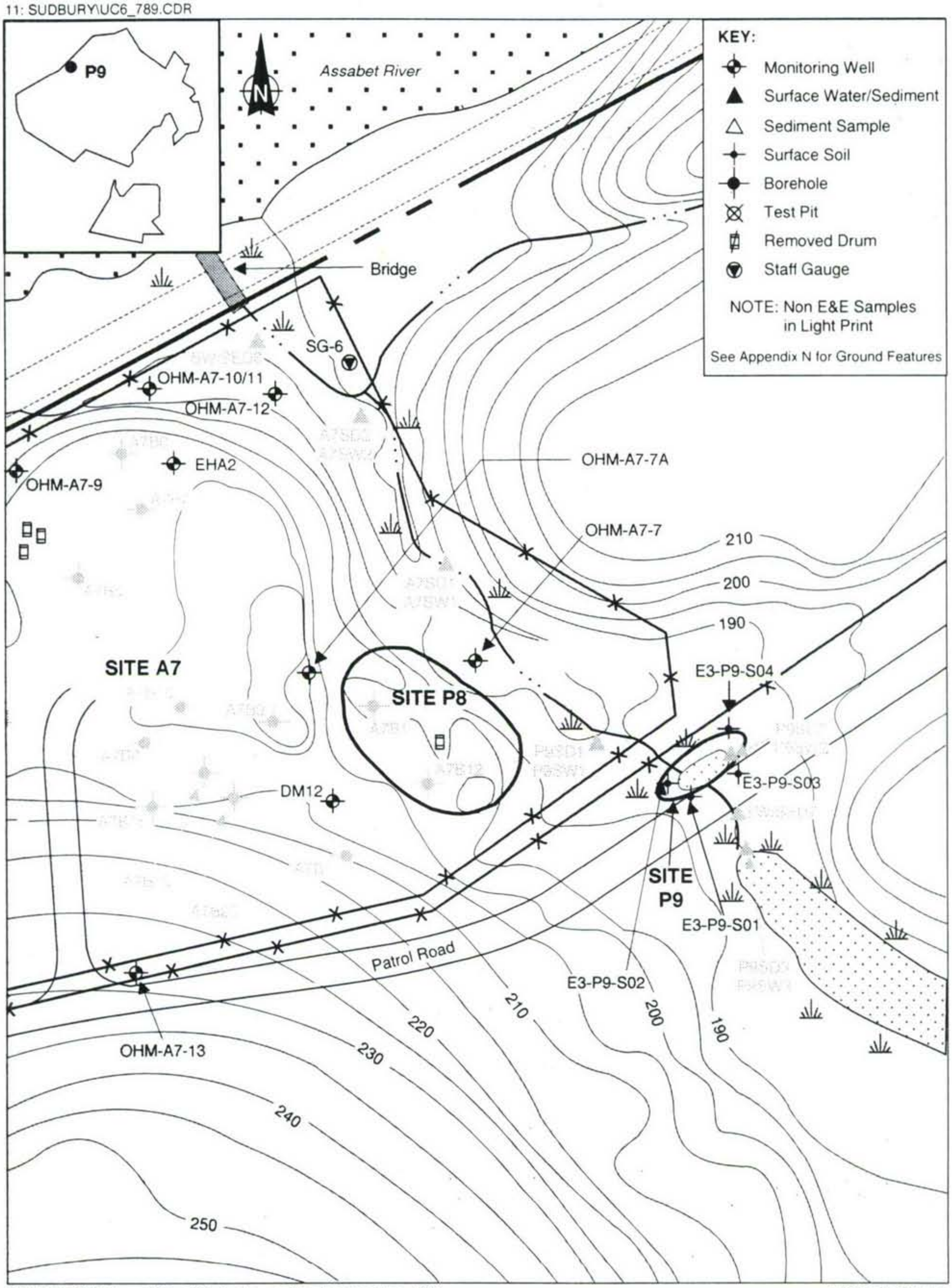
No subsurface exploration was performed at Site P9. Based on information collected from borings and monitoring wells at Site A7, immediately to the west of Site P9, stratigraphy at Site P9 is presumed to be a thin layer of glacial outwash over a thin layer of glacial till. Grain size and Atterberg limits analyses were performed on surface soil sample E3-P9-S02, and identified the surface soil as silty sand with moderate plasticity (liquid limit 35 to 50). Appendix D gives a complete summary of geotechnical results. Bedrock is shallow (from 10 to 20 feet BGS) and has been identified as amphibolitic schist of the Nashoba Formation (Hansen 1956; OHM 1992).

Surface water at Site P9 drains immediately into the small stream crossing the site, which flows into the Assabet River to the north. While no wells were installed at Site P9, topography and drainage indicate that groundwater also discharges immediately to the stream.

4.2.2.3 Ecological Characterization

The site consists of a stream surrounded by a dense forest composed of oak and hardwood trees ranging from 40 to 60 feet in height. Approximately 200 feet to the north of the site across Patrol Road, the vegetation consists of a mature white pine forest with trees

11: SUDBURY\UC6_789.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993.

NOT TO SCALE

Figure 4-3 MAP OF SITE P9, STREAM DUMP AREA

ranging from 40 to 60 feet in height (LFS 1983). The stream is dammed to create a small (16,000 feet^2) pond/wetland south of Patrol Road.

Based on the topography of the area, surface water and groundwater from the site flow into the stream and then north to the Assabet River, approximately 800 feet away. Both sides of the stream are bordered by a narrow seasonally saturated wetland vegetated with deciduous trees (USDOI 1977).

This area combines three productive habitats, upland forest, forested wetland, and open water, to provide an environment likely to support a diverse community. Pines and oaks are very important to wildlife, since upland gamebirds, songbirds, and small mammals rely on pine seeds and acorns as well as on twigs, buds, and flowers for much of their diet (Martin *et al.* 1951). Due to the abundance of nutrients, the presence of diverse woody species, and the availability of water, forested wetlands similar to the one at Site P9 also attract a diverse array of aquatic and upland species, as well as species specifically adapted to wetlands. In addition, the stream and rivers like the Assabet provide edge habitats, drinking water, protected sites for dens and nests, and safe travel corridors for many species. Fish, insects, plants, reptiles, amphibians, birds, and many upland species can be observed in these habitat types.

A population of blazing stars (*Liatris borealis*), a Massachusetts watch-list plant species, was identified on disturbed exposed sandy soil on the southern side of Patrol road and approximately 300 feet northeast of the site (Hunt 1992). No unique habitats are known to occur in the general vicinity of the site (NHESP 1992).

4.2.2.4 Site History

The area was identified through interviews (Fort Devens 1990) as being on the north side of a bridge on Patrol Road that crosses a small drainage. No other information was located concerning this area.

4.2.2.5 Results of Previous Investigations

Previous activities at Site P9 are described in Section 7.8 of the January 1994 *Final Site/Remedial Investigation Report* (OHM 1994).

In 1984, Dames and Moore collected a surface water and a sediment sample from the stream as part of other investigations at the Annex. These samples (SW/SED7) were taken on the upstream side of the bridge and upstream of the suspected dump location. The samples were analyzed for volatile and semivolatile organic compounds, metals with drinking water standards, nitroaromatics, and anions. Elevated levels of iron and manganese were detected in the surface water sample, although these may be reflective of normal background levels in the Sudbury area. A high level of phosphate (1,580 $\mu g/g$) was also present in the sediment.

In 1992, OHM performed an SI that consisted of a site reconnaissance, additional surface water and sediment sampling from both upstream and downstream of Site P9, and sampling from the stream along the north side of Patrol Road. No evidence of disposal was

detected during the reconnaissance. Samples were analyzed for TCL semivolatile and volatile organic compounds, TCL pesticide/PCBS, TAL metals, explosives, and phosphate. Both the upstream sediment sample (P9SD3), and one of the sediment samples (P9SD2) collected on the north side of Patrol Road contained low levels of DDT and its degradation products and other pesticides, including α-chlordane and γ-chlordane. The downstream concentration of phosphate (5 μg/L) in the downstream surface water sample (P9SW1) was also considered unusual. No phosphate was found in any of the P9 sediment samples in 1992.

4.2.2.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical sample at Site P9, were analyzed for TCL organics, TAL metals, and herbicides. One sample was sent for geotechnical analysis to determine grain size and Atterberg limits. In addition, one sample was analyzed for TOC. Table 4-13 provides a summary of Phase II field activities undertaken at the site.

Table 4-13

PHASE II SAMPLING EFFORTS FOR SITE P9 — STREAM DUMP AREA BETWEEN A7 AND A9

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Surface Soils	4	09/14/93	Samples collected to assess the nature of contamination in the area.
	1	09/14/93	Sample collected for TOC analysis.
	1	09/14/93	Geotechnical sample collected to characterize the nature of surface soils and their impacts on contaminant migration.

Source: Ecology and Environment, Inc. 1994.

Surface Soil Sampling

Four surface soil samples were collected from locations suspected to be in the runoff pathways from disposal areas to the stream. The sample information is used to characterize possible impacts from past disposal activities on the area around and downgradient of Site P9. One surface soil sample, EP-P09-S02, was sent for geotechnical analysis to determine grain size and Atterberg limits analyses. E3-P09-S02 was also analyzed for TOC.

4.2.2.7 Nature and Extent of Contamination

The initial concern at Site P9 was that alleged dumping of chemicals at the site, could, if proven to have occurred, have an impact on the surrounding media. No debris or other evidence of disposal is apparent at the site. Analysis of surface soil samples taken by

E & E at the site indicated high levels of arsenic in three out of four soil samples. The highest detection at this site, of 1100 μg/g (E3–P04–S04), was the second highest arsenic detection in E & E soil sampling at the Annex, and was well above the soil screening value of 30 μg/g (MCP GW–1/S–1 and MCP GW–3/S–3 values are both 30 μg/g), and above the Region III RBC for commercial/industrial soils of 310 μg/g. The arsenic detections at two of the other samples (220 μg/g at E3–P09–S01 and 360 μg/g at E3–P09–S02) were also significantly elevated. Arsenic (up to 70 μg/g) was also found in soil samples taken as part of the OHM investigation of Site A9. These Site A9 samples were taken in the runoff path from a culvert that drained the bermed area at Site A9. The culvert outlet is located at the southwest corner of the fenced area at Site A9, and some of the drainage from the culvert may flow into the Site P9 site. It is unknown if this culvert could be a source of the high arsenic concentrations found in soils at Site P9. Table 4-14 presents a summary of detections above preliminary screening levels at the site. A summary of analytical results for Site P9 is presented in Table 4-15 at the end of this section.

Table 4-14

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P9

Medium (Units)	Compound	Max. Background	Screen Level	Source	Max. Concentration	Sample ID	Frequency Above Screen Level
SOIL (μg/g)	Arsenic	10	30	MCP GW-1/S-1[1]	1,100	E3-P09-S04	3/4
	Beryllium	0.446	0.4	MCP GW-1/S-1	0.814	E3-P09-S04	1/4

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

Arsenic was not significantly elevated in an OHM surface water sample (P9SW1) taken downstream of Site P9, nor in surface water samples taken at the site or upstream. Surface water samples taken as part of the OHM investigation of Site A7, further downstream, did not detect arsenic above the reporting limit in one sample, A7SW1, but did find a slightly elevated arsenic level of 9.44 μg/L at A7SW2. In surface water sampling by E & E just upstream of the entrance of this tributary into the Assabet River (E3–BCK–D03), arsenic was detected at a level (1.52 μg/L) below the highest level in background streams at the Annex (3.15 μg/L).

Sediment sampling downstream of Site P9 by OHM (P9SD1) indicated a level of arsenic (11 μg/g) above the maximum concentration in background streams (2.03 μg/g), but only slightly above the maximum concentration in the background pond sediments (9.56 μg/g). Sediment sampling at Site P9 by OHM also indicated a slightly elevated arsenic level (10 μg/g) at sediment sampling location P9SD2. Arsenic was not elevated in the upstream sediment sample taken by OHM (P9SD4). Sediment samples taken further downstream as part of the OHM investigation of Site A7 also had slightly elevated arsenic levels (14 μg/g at A7SD12 and 12 μg/g at A7SD2). Sediment sampling by E & E just upstream of where this

tributary enters the Assabet River (E3-BCK-D03) indicated a level of arsenic (2.95 μg/g) slightly above the highest levels in background streams at the Annex (2.03 μg/g).

The only other detection in soils at Site P9 that was above soil screening values was beryllium in E3-P09-S04 (where arsenic was also at a maximum), at 0.814 μg/gm, which is above the screening value of 0.4 μg/g. The beryllium detection is well below the MCP GW-3/S-3 value of 3 μg/g but above the Region III RBC for commercial/industrial soils of 0.67 μg/g. Several other metals were elevated above background in soil samples at the site, but were below screening values. Almost all of the metals detected in sample E3-P09-S04 were above background levels.

Numerous PAH compounds were detected in soils at the site, particularly in samples E3-P09-S01 and E3-P09-S04, but were also below soil screening values. Given the location of this site directly adjacent to Patrol Road, these PAH detections may be related to passing automobile traffic. The PAH levels could also be result of the petroleum burning activities at the POL Burn Area (Site A9), which is approximately 500 feet northeast of the site.

Trace levels of numerous pesticides were also detected in soil samples at this site, but only β-endosulfan (0.005 μg/g), endrin (0.170 μg/g), γ-chlordane (0.109 μg/g) heptachlor epoxide (0.018 μg/g), and DDT and its degradation products were found in concentrations above the highest levels in background soil samples. DDT (0.280 μg/g), DDD (0.116 μg/g), and DDE (0.350 μg/) were only detected above background in sample E3-P09-S04, where levels of metals were also the highest. None of the pesticide levels were elevated above soil screening values. Some low levels of DDT and its degradation products, and α- and γ-chlordane, were also detected in OHM sediment sampling at the site and upstream of the site, but not in the downstream sediment sample. The levels of pesticides detected in OHM sediment sampling upstream and at the site area are above the lowest effect levels used as screening values for this study, and are also above site-specific criteria from NYSDEC and EPA that were adjusted for TOC content of the OHM sediment samples.

4.2.2.8 Conclusions and Recommendations

The arsenic levels detected in soils at the site indicate some potential surficial arsenic contamination at this site. The exact source of this arsenic is unknown. Arsenic was previously detected in several drum confirmation samples taken by OHM elsewhere at the Annex, which could indicate that an arsenic-based herbicide or other arsenic-based compound was being used at the Annex. However, arsenic has also been detected at elevated levels at the former pyrotechnics range (Site P27), the Rocket Range/Railroad Classification Yard (Site P28), and at several bunkers in the area adjacent to Puffer Pond (Sites P16 and P54). Arsenic levels in surface water and sediment downstream of the site indicate some slightly elevated levels above background that may be related to the site. Arsenic was found in soil samples southwest of Site A9 below a culvert that is upgradient of Site P9. Upstream samples in the tributary to the Assabet do not indicate elevated levels of arsenic, which rules out a source such as former Building S449 (Site P57).

The low-level pesticide detections at the site do not appear site-related and are similar to other low-level pesticide detections across the Annex. The source of the pesticide detections is probably from general spraying practices at the Annex.

The presence of elevated arsenic levels in soil samples below the culvert discharging from Site A9 suggests that Site A9 could be a source of arsenic at Site P9. It is also possible that chemical dumping at Site P9 itself could be a source. The extent of arsenic at Site P9 has not been fully characterized and soil sampling is recommended to better assess the nature and extent of contamination. A series of soil samples taken along the centerline of the drainage from Site A9 should be taken to assess the possibility of this being the migration route of the arsenic. To assess the extent of arsenic at P9 itself, a 4-point grid around E3-P09-S04 (where the highest concentration of arsenic was found), should be sampled, along with three samples collected in an arc at a 15-foot radius from southwest to northwest of E3-P09-S02 and three samples collected in an arc at a 15-foot radius from northeast to northwest of E3-P09-S04.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 4-15
Chemical Summary Report For Surficial Soils
Site: P09
Units: UGG

Test	Parameter	E3-P09-S01	E3-P09-S01	E3-P09-S02	E3-P09-S03	E3-P09-S04	
	Field Sample ID	SDP09011	SXP09011	SXP09021	SXP09031	SXP09041	
	Sample Date	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93	
TAL METAL	Aluminum	7480	7150	8710	6170	21000 !	
	Antimony	2.47 !	2.47 !	2.72 L!	< 0.500 L	3.67 L!	
	Arsenic	200 !@	220 !@	360 !@	12.1 !	1100 !@	
	Barium	25.7 !	25.1	22.8	25.3 !	48.1 !	
	Beryllium	0.318 J	0.281 J	0.366 J	0.243 J	0.814 !@	
	Calcium	422 J	403 J	476 J	669	448 J	
	Chromium	14.3 !	12.3	12.2	11.3	21.4 !	
	Cobalt	5.23	5.23	5.04	5.25	9.03 !	
	Copper	11.5 !	10.4	13.3 !	9.96	29.6 !	
	Iron	10500	9700	11000	10300	20000 !	
	Lead	17.0	15.0	33.0	11.4	36.0	
	Magnesium	2180	2210	1680	2030	2550 !	
	Manganese	83.4	85.5	130 !	86.4	350 !	
	Nickel	9.83	9.62	9.41	8.26	14.3 !	
	Potassium	1160 !	1210 !	736 !	1340 !	783 !	
	Selenium	< 0.200	< 0.200	< 0.200 L	< 0.200 L	0.320 L	
	Sodium	170 KJ	129 BJ	188 KJ	212 KJ	282 J	
	Thallium	< 0.500	< 0.500	0.539 J	< 0.500	0.784	
	Vanadium	19.5	17.6	20.2	17.6	31.1	
	Zinc	26.8	32.3	79.1 !	34.7	67.7 !	
TCL BNA	Acenaphthylene	< 0.330	0.043 J	< 0.330	< 0.330	< 0.330	
	Benzo(a)anthracene	0.120 J	0.230 J	< 0.330	< 0.330	0.200 J	
	Benzo(a)pyrene	0.200 J	0.330 J	< 0.330	< 0.330	0.320 J	
	Benzo(b)fluoranthene	0.280 J	0.450	0.081 J	< 0.330	0.510	
	Benzo(ghi)perylene	0.150 J	0.210 J	< 0.330	< 0.330	0.230 J	
	Benzo(k)fluoranthene	0.083 J	0.110 J	< 0.330	< 0.330	0.200 J	
	Chrysene	0.190 J	0.280 J	< 0.330	< 0.330	0.320 J	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 4-15

Chemical Summary Report For Surficial Soils

Site: P09

Units: UGG

Test	Site ID	E3-P09-S01	E3-P09-S01	E3-P09-S02	E3-P09-S03	E3-P09-S04	
	Field Sample ID	SDP09011	SXP09011	SXP09021	SXP09031	SXP09041	
	Sample Date	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93	
Test	Parameter .						
TCL BNA	Dibenzo(a,h)anthracene	< 0.330	< 0.330	< 0.330	< 0.330	0.062 J	
	Fluoranthene	0.220 J	0.360 J	0.091 J	< 0.330	0.330	
	Indeno(1,2,3-cd)pyrene	0.160 J	0.160 J	< 0.330	< 0.330	0.220 J	
	Phenanthrene	0.091 J	0.120 J	< 0.330	< 0.330	0.140 J	
	Pyrene	0.300 J	0.450	0.100 J	< 0.330	0.410 J	
TCL Pest	Endosulfan,A	0.001 JC	0.001 JC	0.000 JC	< 0.002	< 0.002	
	Endosulfan,B	0.005 C	0.005 C	0.001 JU	< 0.002	0.003 C	
	Endrin	0.039 JU!	0.021 JU!	< 0.002	0.170 C!	< 0.002	
	Endrin Aldehyde	< 0.002	< 0.002	< 0.002	0.007 C	< 0.002	
	Heptachlor Epoxide	0.003 C!	0.003 C!	0.002 JC!	0.018 C!	0.001 JC	
	Lindane	0.001 JU	< 0.002	< 0.002	0.001 JU	0.001 JC	
	P,P-DDD	0.022 U	0.031 U	0.014 U	0.020 U	0.116 C!	
	P,P-DDE	0.029 C	0.031 C	0.059 C	0.020 C	0.350 C!	
	P,P-DDT	0.058 C	0.089 C	0.042 C	0.019 C	0.280 C!	
	alpha-Chlordane	0.008 JC	0.004 JC	< 0.002	0.160 C	0.002 JU	
	gamma-Chlordane	0.004 JC	0.002 JC	< 0.002	0.109 C!	< 0.002	
TOC	Total Organic Carbon			41200			

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

4.2.3 Site P57 — Former Building S449

The building was identified during field activities conducted by OHM at the Annex in 1992 (OHM 1994a). Figure 4-4 presents a site map.

4.2.3.1 Site Location

Site P57 is located on the northwestern side of White Pond Road in the northern part of the Annex, about 1,600 feet southwest of the north intersection of White Pond Road with Patrol Road. Immediately south of a pink fire hydrant, and just north of an old stone wall on White Pond Road, there is an old paved road that diverges northwest into Site P57. The paved road curves to the west and ends in a small partially overgrown clearing, while an unpaved road continues straight into another old clearing. In the center of the western clearing, there is a soil mound with scattered metal debris, plastic tubing, and broken concrete blocks. Between the two cleared areas, there are several 10-foot-long metal bars and a 6-foot by 6-foot concrete foundation with protruding metal cables.

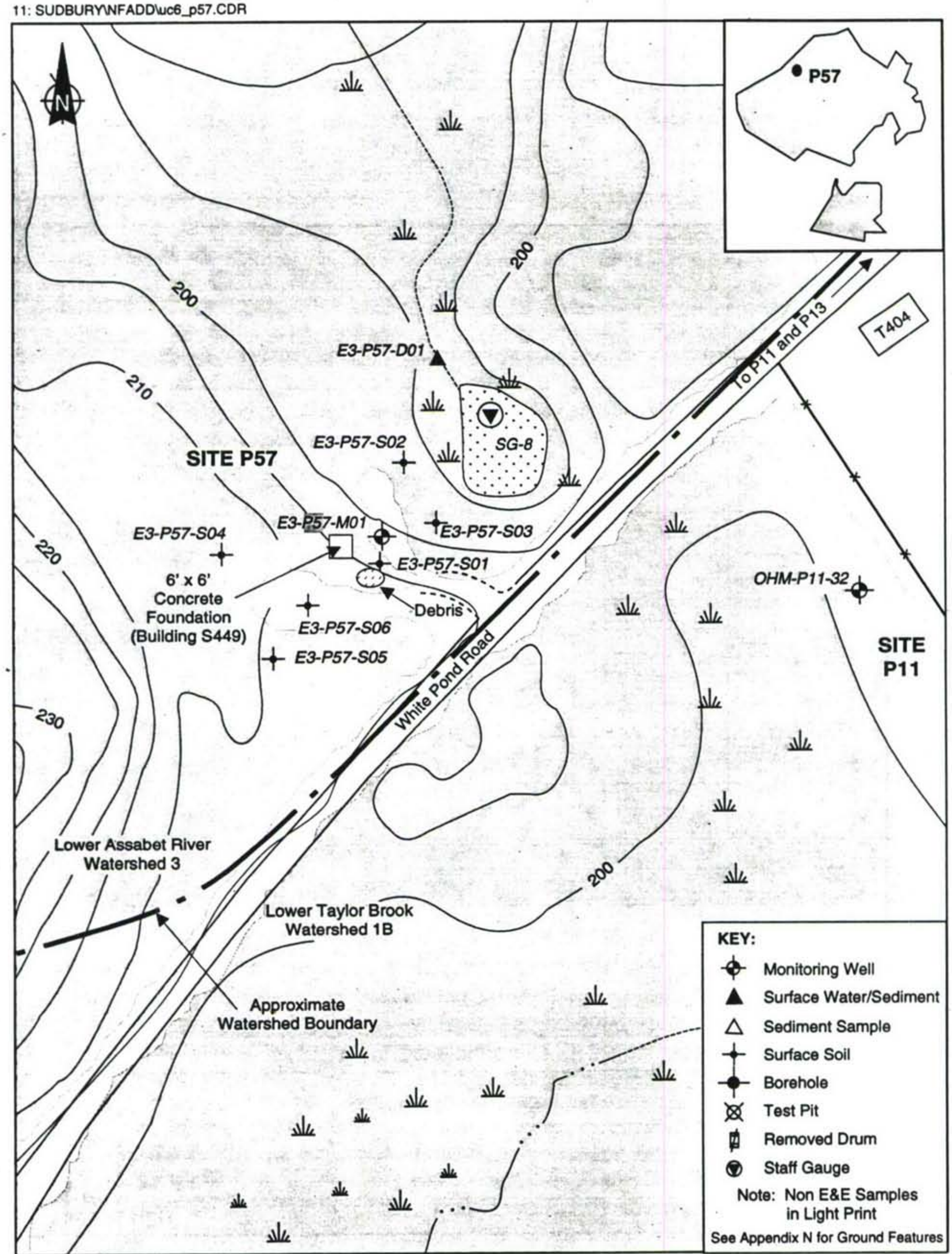
4.2.3.2 Physical Characteristics

Site P57 lies on a kame terrace of sand and gravel, bordering a ground moraine of glacial till situated west of Site P57. Surface elevations at Site P57 range from 195 to 210 feet AMSL. The average groundwater elevation at Site P57, as estimated from water level measurements collected at well E3-P57-M01, is 182 feet AMSL.

A single monitoring well was installed at Site P57 by E & E in 1993. Bore logs indicate that kame terrace material consisting of well-defined layers of silty sand with some small gravel extended to a depth of 11 feet. Glacial till was encountered from 11 to 19 feet BGS. The total depth of the boring at well E3-P57-M01 was 19 feet. A soil sample collected from the 9 to 11 foot interval of the boring was submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as non-plastic, poorly graded sand with silt and gravel. Additional grain size and Atterberg limits analyses were performed on surface soil sample E3-P57-S03 and on sediment sample E3-P57-D01. The surface soil was identified as silty sand of moderate plasticity (liquid limit 35 to 50). The sediment sample was identified as organic silt with sand of high plasticity (liquid limit >70). Appendix D has complete geotechnical laboratory reports. Bedrock was not encountered during well installation, so depth to bedrock is unknown but it is probably shallow (less than 30 feet). Outcrops on the nearby ground moraine indicate that the underlying bedrock material is probably Gospel Hill Gneiss (Hansen 1956).

A slug test performed at monitoring well E3-P57-M01 by E & E in 1993 yielded a transmissivity calculation of 4.94 feet^2 per day. Aquifer thickness was presumed to be equal to the length of the water column in the well at the time of the slug test. This very low transmissivity is typical of the tight till in which the well was installed; however, a

11: SUDBURY\NFADD\uc6_p57.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 4-4 MAP OF SITE P57 FORMER BUILDING S449

conservative estimate of aquifer thickness may have resulted in an underestimate of transmissivity. The transmissivity was calculated as follows:

$$T = Kb$$
$$T = (0.5829)\ (8.48)$$
$$T = 4.94 \text{ feet}^2 \text{ per day}$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet^2 per day)
b = Aquifer thickness (feet)

Complete slug test data and interpretation can be found in Appendix G.

Surface water at Site P57 flows northeast to a small wetland area. Water levels observed at well E3–P57–M01 and in the nearby wetland and other hydrogeological data from Sites P11/P13 indicate that groundwater flows northeast to the wetland. During drier periods, flow may bypass the wetland and flow north-northeast to a perennial spring and tributary of the Assabet River.

4.2.3.3 Ecological Characterization

Except for the old paved access road and a small clearing, which is the old site of Building S449, most of the site is vegetated with densely growing white pines and oaks ranging from 40 to 60 feet in height. A thick mat of needles covers the ground underneath the pines and the understory consists almost exclusively of regenerating overstory. To the south and to the west of the site, the species composition of the forest changes to mixed oaks ranging from 30 to 40 feet in height (LFS 1983). The on-site clearing is undergoing field succession; it is currently vegetated with a mixture of grasses, forbs, and saplings.

Groundwater from the site generally flows northeast towards a small wetland approximately 400 feet away. This wetland is seasonally saturated and forested with deciduous trees. Two-hundred feet south of the site are two more wetlands that may also be affected by conditions at the site. The larger one is seasonally saturated and forested with deciduous trees, while the smaller one is a semipermanent wetland vegetated with emergent plants including cattails and bulrushes.

This area consists of three different habitats: open areas, mixed upland forest, and forested and emergent wetland. The small, revegetating clearing surrounded by forest constitutes an edge habitat, which supports a distinct community of birds and mammals that depend on both forested and open areas. Pine and oak trees are of great importance to wildlife: waterfowl, upland gamebirds, songbirds, small mammals, and deer consume acorns (Martin *et al.* 1951). In addition, reptiles and amphibians find food and shelter beneath the thick mat of slowly-decaying oak leaves. Forested as well as emergent wetlands such as the

ones south of the site are expected to sustain a diverse array of aquatic and upland species, as well as species specifically adapted to wetlands.

There is no evidence that any rare, threatened, or endangered species occur in the general vicinity of the site. Similarly, no unique habitats have been identified near Site P57 (NHESP 1992).

4.2.3.4 Site History

Site P57 is the location of a demolished building that had several historical uses. It was constructed in 1952, and designated Building T449. From 1952 until 1958, it was known as the "press house" and may have housed printing presses. From 1958 until possibly as late as 1969, the USAF used the building for calibration of equipment. Finally, sometime around 1977, the building may have been used by the Natick Food Science Laboratories for research on the study of toxic fumigants. This building was known as Building T449 from its construction in 1952 until 1965, when its designation was changed to Building S449.

From 1958 until at least 1965, the USAF leased part of the building. A 1960 USAF letter requested the renewal of a lease for the use of 200 square feet in Building T449 for use by the Photo Chemistry Laboratory, Geophysics Research Directorate, of Hanscom Air Force Base. The requested space would be used for a USAF project involving the calibration of accelerometers.

A 1965 Army inspection of the building noted that no personnel were currently using the building. At a meeting in 1965, the USAF representative agreed to vacate a portion of Building T449 for use by Natick Laboratories as "an isolation and observation ward for animals" (referred to also as "zoonosis" facility). However, by April 1967, the USAF was again using the entire building, so it is questionable whether Natick Laboratories actually used the building for a "zoonosis." The USAF continued to use the building until October 1969.

The 1977 Natick Analysis of Existing Facilities (Natick Laboratories 1977) noted that the building had been assigned to the Food Science Laboratory for study of the effects of toxic fumigants on insects. It is unknown whether this activity was actually carried out at Site P57, and if so, what kind of specific research may have been conducted. Building S449 was apparently demolished sometime before 1984, as it does not appear on a 1984 facility map.

4.2.3.5 Result of Previous Investigations

No previous investigations have been conducted at Site P57.

4.2.3.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics and TAL metals. Surface soil

samples, a subsurface soil sample and a sediment sample were also analyzed for TOC and were sent for grain size analysis. Table 4-16 provides a summary of field activities conducted at the site.

Table 4-16

PHASE II SAMPLING EFFORTS FOR SITE P57 — FORMER BUILDING S449

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	2	08/25/93 12/03/93 01/11/93	Samples were collected to assess groundwater quality and the potential for off-site contaminant migration.
Subsurface Soils	1	08/10/93	Sample was collected from the screened interval in the well and sent for TOC analysis to assess migration rates in groundwater.
	1	08/10/93	Geotechnical sample was collected for grain size and Atterberg limit analyses to provide data on aquifer characteristics.
Surface Soils	6	08/26/93	Samples were collected to investigate surface contamination due to past site activities in and around Building S449.
	6	08/26/93	Samples were collected and sent for TOC analysis to characterize nature of surface soils on site and their sorption characteristics.
Sediment	1	09/16/93	Sample was collected to investigate stream contamination due to surface runoff or groundwater discharge from Site P57.
	1	09/16/93	Sample was collected and sent for grain size and Atterberg limit analyses to characterize the physical properties of stream sediments.
	1	09/16/93	Sample was collected and sent for TOC analysis to characterize sorption characteristics of the sediments.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

In order to characterize groundwater quality, E & E installed, developed, and sampled one shallow overburden well, E3-P57-M01. The well is located northeast and downgradient of the foundation for Building S449, approximately 15 feet downhill from the foundation and roughly 75 feet from the intermittent stream to the north. The well was screened across the water table at an interval 9 to 19 feet BGS. Two rounds of groundwater

samples were collected from the well during August and December 1993, with both filtered and unfiltered samples collected at each round. Groundwater sampling provides data to investigate whether past activates at Building S449 have impacted the groundwater in the area and whether off-site contaminant migration is an environmental concern.

As a result of QA/QC protocols approved in the QAPjP, E & E resampled well E3-P57-M01 in January 1994 and analyzed samples for TCL volatiles.

Subsurface Soil Sampling

During monitoring well installation, a geotechnical sample was collected from the screened interval at 9 to 11 feet BGS to characterize the nature of the subsurface soils and their impact on the groundwater pathway. An additional sample, E3-P57-D01, was collected from the screened interval and sent for TOC analysis to provide further data on the nature of the subsurface soils.

Sediment Sampling

One sediment sample was collected from the streambed downgradient of Site P57. The sample was collected from a point where sediments had accumulated, downstream of surface runoff channels originating in the area surrounding Building S449 (Site P57). Due to the lack of water, no surface water sample was collected at location E3-P57-D01, although one was specified in the June 1993 *Technical Plan Addenda*. An additional sample was collected and sent for TOC analysis to characterize the nature of the surface soils in the streambed. Geotechnical samples were also collected and sent for grain size and Atterberg limit analyses to further characterize the nature of the streambed soils and their impact upon potential contaminant migration through the surface water pathway.

4.2.3.7 Nature and Extent of Contamination

The initial concern at this site was whether the variety of historical activities at the former Building S449 on the site have resulted in the release of hazardous constituents into surrounding media. A particular concern was whether the alleged use of the building for fumigant research may have resulted in a release of toxic fumigants. Table 4-17 provides a summary of detections above preliminary screening levels at the site. A summary of analytical results for Site P57 is provided at the end of the conclusions and recommendations section (Tables 4-18, 4-19, and 4-20).

Analysis of filtered groundwater samples from the newly installed well (E3-P57-M01) did not indicate any contamination in groundwater at the site. The only constituent found at a level above the screening value was manganese (99.0 μg/L), which exceeds the Massachusetts Secondary MCL of 50 μg/L. This level is consistent with manganese detections in other filtered groundwater samples at the Annex, and probably

Table 4-17

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P57

Medium (Units)	Compound	Maximum Background	Screen Level	Source	Maximum Concentration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1] Aluminum(F)[2]		50	MA SMCL[3]	7,870 <25.0	E3-P57-M01 E3-P57-M01	
	Iron(U) Iron(F)		300	MA SMCL	12,000 <25.0	E3-P57-M01 P3-P57-M01	
	Manganese(F) Manganese(U)	--	50	MA SMCL	99.0 112	E3-P57-M01 E3-P57-M01	1/1
SOIL (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[4]	0.462(J)[6]	E3-P57-S05	1/7
	Benzo(*a*) anthracene	--	0.7	MCP GW-1/S1	1.10	E3-P57-S01	2/7
	Benzo(*a*) pyrene	--	0.7	MCP GW-1/S-1	0.760	E3-P57-S01	1/7
	Benzo(*b*) fluoranthene	--	0.7	MCP GW-1/S-1	1.30	E3-P57-S01	2/7
	Chrysene	--	0.7	MCP GW-1/S-1	1.30	E3-P57-S01	2/7
SED (μg/g)	Beryllium	0.18	0.4	MCP GW-1/S-1	0.893(L)[7]	E3-P57-D01	1/1
	Cadmium	0.357	0.6	Ontario MOE LEL[4]	1.35	E3-P57-D01	1/1
	Lead	4.48	31	Ontario MOE LEL	75.0	E3-P57-D01	1/1
	Mercury	--	0.15	NOAA ERL[5]	0.228(J)[6]	E3-P57-D01	1/1
	α-Chlordane	--	0.0005	NOAA ERL (for Chlordane)	0.005	E3-P57-D01	1/1
	Dieldrin	--	0.00002	NOAA ERL	0.013	E3-P57-D01	1/1
	Endrin	--	0.00002	NOAA ERL	0.016	E3-P57-D01	1/1
	DDD	--	0.002	NOAA ERL	0.044	E3-P57-D01	1/1
	DDE	0.0015	0.002	NOAA ERL	0.080	E3-P57-D01	1/1
	DDT	--	0.001	NOAA ERL	0.016	E3-P57-D01	1/1

[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[5]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range Low Sediment Level.
[6] J = Estimated Value.
[7] L = Result bias low.

Source: Ecology and Environment, Inc. 1994.

reflects the naturally occurring levels of manganese. In addition, groundwater from this site is not used as drinking water, and is most unlikely to be used in the future, given the very low potential yield of the glacial till underneath the site.

The only potential contamination detected in surface soil samples taken at Site P57 was elevated levels of various PAH compounds in one sample (E3-P57-S01) taken near the metal and concrete debris in the center of the site. Benzo(*a*)anthracene (1.10 μg/g), benzo(*a*)pyrene (0.760 μg/g), benzo(*b*)fluoranthene (1.30 μg/g) and chrysene (1.30 μg/g) were found in this sample at levels above the screening value for these compounds of 0.7 μg/g (MCP GW-1/S-1 and GW-3/S-3 value). None of these compounds were detected at levels approaching the screening values in the two soil samples taken in runoff paths from the debris at the site (E3-P57-S02 and E3-P57-S03) or in the samples taken in the western clearing.

Several metals were slightly elevated above background in some of the soil samples, but none were found in concentrations above soil screening values. Trace levels of pesticides were detected in the soil samples, but only β-endosulfan (0.006 μg/g), methoxychlor (0.022 μg/g), DDE (0.930 μg/g), and DDT (1.90 μg/g), all at sample E3-P57-S01, were above the maximum detections in background for these pesticides.

A surface water sample could not be taken in the September sampling round at this site, because of a lack of water in the drainage from the small wetland northeast of the site. The wetland itself did not have much standing water at the time of the September sampling, and the drainage path was quite dry. A sediment sample was taken in the drainage path from the wetland in the September sampling round. Analysis of this sample indicated elevated levels of aluminum, antimony, barium, beryllium, cadmium, calcium, chromium, copper, nickel, and selenium above background levels for both soil and stream sediments. Arsenic, cobalt, iron, lead, manganese, sodium, and vanadium were found at levels above background stream sediments but below soil background levels. Only beryllium, cadmium, lead, and mercury were found at levels above screening values. Beryllium was detected at 0.893 μg/g, which exceeds the screening value of 0.4 μg/g (MCP GW-1/S-1), but is well below the MCP GW-3/S-3 value of 3 μg/g. Cadmium was detected at 1.35 μg/g, which is above the sediment screening value of 0.6 μg/g (Ontario MOE LEL), but below the NOAA ERL of 5 μg/g and the NOAA ERM value of 9 μg/g. The lead detection (75.0 μg/g) was above the screening value of 31 μg/g (Ontario MOE LEL), but below the NOAA ERM level of 110 μg/g. Mercury was detected at 0.228 μg/g (estimate), which is slightly above the NOAA ERL of 0.15 μg/g, but below the NOAA ERM of 1.3 μg/g.

Several PAHs were detected in the sediment sample at levels below the sediment screening value, although no sediment screening value could be found for benzo(*b*)fluoranthene, which was detected at 0.140 μg/g. This detection is well below the soil screening value of 0.7 μg/g (MCP GW-1/S-1). This compound is likely to be an artifact of field sampling. Several pesticides were found at levels above the lowest-effect levels used for sediment screening, but were below NYSDEC and EPA sediment quality criteria that were adjusted for the TOC content of the sediment sample (234,000 μg/g or 23.4 percent).

4.2.3.8 Conclusions and Recommendations

Some low level of PAH compounds were detected in the immediate vicinity of the metal and concrete debris at Site P57, but these are not widespread in soils at the site. Elevated levels of several metals, including cadmium, lead, and mercury, were detected in a sediment sample taken downgradient of the wetland northeast of the site at levels above the Ontario MOE LEL for benthic organisms, but below the NOAA ERM values for these compounds. Given that groundwater and soil sampling did not indicate elevated levels of cadmium, lead, or mercury, it is unlikely that elevated levels in the sediment sample are the result of contamination from Site P57. These metal concentrations in the sediment were well below any human health oriented soil screening values, and may reflect naturally occurring levels of these metals in the wetland vicinity and the extremely high organic carbon content of the sample (23.4 percent). Some trace levels of pesticides were detected in the sediment sample above lowest-effect levels for benthic aquatic organisms, but below NYSDEC and EPA sediment quality criteria that were adjusted for the TOC content of the sediment sample. Given that pesticides were not detected above the NYSDEC and EPA criteria, it is unlikely that there is pesticide contamination of sediments in the drainage from the site. The source of the low-level pesticides detected is likely to be pesticide spraying practices at the Annex in the past, rather than any site-related source.

Sampling results did not identify any site-related contamination other than low-level PAH concentrations in the immediate area around the metal and concrete debris in the center of the site. Given that no impacts were detected in groundwater, sediment, or soils outside of this one area, no further action is recommended at this site.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 4-18
Chemical Summary Report For Groundwater
Site: P57
Units: UGL

	Site ID	E3-P57-M01	E3-P57-M01	E3-P57-M01	E3-P57-M01	E3-P57-M01	
	Field Sample ID	MF5701X1	MFP57012	MX5701X1	MXP57012	MXP57013	
	Sample Date	08/25/93	12/03/93	08/25/93	12/03/93	01/11/94	
Test	Parameter						
TAL METAL	Aluminum	< 25.0	17.5 BJ		7870 @		
	Antimony	5.15 B	4.96 BJ		2.04 J		
	Arsenic	< 2.00	< 2.00		2.14		
	Barium	8.30 J	6.71 J		42.8		
	Beryllium	< 5.00	< 5.00		0.229 J		
	Calcium	6880	7790		8690		
	Chromium	< 10.0	< 10.0		17.8		
	Cobalt	< 10.0	< 10.0		8.11 J		
	Copper	3.26 J	< 10.0		15.1		
	Iron	< 25.0	< 25.0		12000 @		
	Lead	< 5.00	1.14 J		4.90 J		
	Magnesium	1020	990		3630		
	Manganese	99.0 @	26.7		112 @		
	Nickel	< 10.0	< 10.0		16.9		
	Potassium	2500	1620		4180		
	Sodium	2830	2750 B		3180 B		
	Vanadium	< 10.0	< 10.0		22.1		
	Zinc	22.3 B	6.55 BJ		66.4		
TCL VOA	Carbon disulfide			< 5.00		4.30 J	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 4-19
Chemical Summary Report For Surficial Soils
Site: P57
Units: UGG

Test	Parameter	E3-P57-S01	E3-P57-S01	E3-P57-S02	E3-P57-S03	E3-P57-S04	E3-P57-S05
	Field Sample ID	SDP57011	SXP57011	SXP57021	SXP57031	SXP57041	SXP57051
	Sample Date	08/26/93	08/26/93	08/26/93	08/26/93	08/26/93	08/26/93
TAL METAL	Aluminum	9700	9460	8930	8770	11000 !	15000 !
	Arsenic	7.37	6.34	6.10	6.10	5.82	5.49
	Barium	19.7	21.7	18.2	20.0	16.6	20.9
	Beryllium	0.332 J	0.329 J	0.304 J	0.302 J	0.382 J	0.462 J!@
	Calcium	< 500	< 500	< 500	337 J	< 500	< 500
	Chromium	13.6	12.9	13.3	11.0	13.6	16.9 !
	Cobalt	4.22 K	4.52 K	4.62 K	3.85 K	4.67 K	5.66 K
	Copper	10.8 !	11.8 !	7.81	6.75	6.39	5.73
	Iron	10700	10300	10200	9300	10400	12000
	Lead	24.0	25.0	24.0	25.0	16.0	9.60
	Magnesium	1430	1390	1690	1220	1460	1490
	Manganese	88.3	83.6	107 !	107 !	76.4	81.3
	Nickel	8.09	8.38	9.08	7.68	9.00	9.97
	Potassium	437 K	489 K	551 K	382 K	425 K	369 K
	Selenium	0.544	0.314	0.331	0.359	0.436	0.433
	Sodium	149 KJ	< 200	< 200	< 200	< 200	< 200
	Vanadium	19.8	19.0	19.5	18.9	19.2	21.7
	Zinc	28.7 K	31.1 K	18.2 K	19.7 K	19.3 K	19.3 K
TCL BNA	Anthracene	0.042 J	0.077 JL	< 0.330	< 0.330	< 0.330	< 0.330
	BJFANT		0.570				
	Benzo(a)anthracene	1.10 @	0.740 L@	< 0.330	< 0.330	< 0.330	< 0.330
	Benzo(a)pyrene	0.760 @	0.480 L	< 0.330	< 0.330	< 0.330	< 0.330
	Benzo(b)fluoranthene	1.30 J@	0.730 JL@	0.069 J	< 0.330	< 0.330	< 0.330
	Benzo(ghi)perylene	0.400 J	0.180 JL	< 0.330	< 0.330	< 0.330	< 0.330
	Benzo(k)fluoranthene	0.420	0.360 L	< 0.330	< 0.330	< 0.330	< 0.330
	Chrysene	1.30 @	0.790 L@	< 0.330	< 0.330	< 0.330	< 0.330
	Dibenzo(a,h)anthracene	0.150 J	< 0.330 L	< 0.330	< 0.330	< 0.330	< 0.330

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 4-19
Chemical Summary Report For Surficial Soils
Site: P57
Units: UGG

	Site ID	E3-P57-S01	E3-P57-S01	E3-P57-S02	E3-P57-S03	E3-P57-S04	E3-P57-S05
	Field Sample ID	SDP57011	SXP57011	SXP57021	SXP57031	SXP57041	SXP57051
	Sample Date	08/26/93	08/26/93	08/26/93	08/26/93	08/26/93	08/26/93
Test	Parameter .						
TCL BNA	Fluoranthene	1.00	1.10 L	0.057 J	0.071 J	0.055 J	< 0.330
	Hexadecanoic Acid						
	Indeno(1,2,3-cd)pyrene	0.430 J	0.230 JL	< 0.330	< 0.330	< 0.330	< 0.330
	Phenanthrene	0.140 J	0.230 JL	< 0.330	< 0.330	< 0.330	< 0.330
	Pyrene	1.60	1.30 L	0.069 J	0.079 J	0.065 J	< 0.330
TCL Pest	Endosulfan,B	0.006 U!	0.005 U	< 0.002	0.001 JC	< 0.002	< 0.002
	Methoxychlor	0.022 JC	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
	P,P-DDE	0.930 JC!	0.500 JC!	0.066 C	0.078 C	0.019 C	0.035 C
	P,P-DDT	1.90 JC!	1.00 JC!	0.060 C	0.033 C	0.034 C	0.024 C
	alpha-Chlordane	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
TOC	Total Organic Carbon	61500	69700	62300	75200	48500	45600/

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 4-19
Chemical Summary Report For Surficial Soils
Site: P57
Units: UGG

	Site ID	E3-P57-S06					
	Field Sample ID	SXP57061					
	Sample Date	08/26/93					
Test	Parameter						
TAL METAL	Aluminum	5190					
	Arsenic	3.71					
	Barium	25.8 !					
	Beryllium	0.186 J					
	Calcium	658					
	Chromium	12.2					
	Cobalt	7.43 K!					
	Copper	6.80					
	Iron	9500					
	Lead	6.66					
	Magnesium	2090					
	Manganese	75.8					
	Nickel	8.30					
	Potassium	1440 !					
	Selenium	< 0.200					
	Sodium	< 200					
	Vanadium	16.3					
	Zinc	17.8 K					
TCL BNA	Anthracene	< 0.330					
	BJFANT						
	Benzo(a)anthracene	< 0.330					
	Benzo(a)pyrene	< 0.330					
	Benzo(b)fluoranthene	< 0.330					
	Benzo(ghi)perylene	< 0.330					
	Benzo(k)fluoranthene	< 0.330					
	Chrysene	< 0.330					
	Dibenzo(a,h)anthracene	< 0.330					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 4-19
Chemical Summary Report For Surficial Soils
Site: P57
Units: UGG

	Site ID	E3-P57-S06					
	Field Sample ID	SXP57061					
	Sample Date	08/26/93					
Test	Parameter .						
TCL BNA	Fluoranthene	< 0.330					
	Hexadecanoic Acid	0.340					
	Indeno(1,2,3-cd)pyrene	< 0.330					
	Phenanthrene	< 0.330					
	Pyrene	< 0.330					
TCL Pest	Endosulfan,B	< 0.002					
	Methoxychlor	< 0.020					
	P,P-DDE	0.001 JC					
	P,P-DDT	0.007 C					
	alpha-Chlordane	0.000 JC					
TOC	Total Organic Carbon	9840					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. # = Exceeds ecological screening value
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. @= Exceeds human health screening value. != Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 4-20
Chemical Summary Report For Sediments
Site: P57
Units: UGG

	Site ID	E3-P57-D01					
	Field Sample ID	DXP57011					
	Sample Date	09/16/93					
Test	Parameter .						
TAL METAL	Aluminum	18500 !					
	Arsenic	4.44 !					
	Barium	73.5 !					
	Beryllium	0.893 JL!@					
	Cadmium	1.35 K#					
	Calcium	1940 !					
	Chromium	19.8 !					
	Cobalt	4.89 !					
	Copper	13.6 L!					
	Iron	7830 !					
	Lead	75.0 J!#					
	Magnesium	204000 !					
	Manganese	76.7 !					
	Mercury	0.228 J#					
	Nickel	11.7 !					
	Potassium	791					
	Selenium	1.16 !					
	Vanadium	25.8 !					
	Zinc	51.3 J!					
TCL BNA	Benzo(a)pyrene	0.066 J					
	Benzo(b)fluoranthene	0.140 J					
	C15	0.260					
	Fluoranthene	0.110 J					
	Pyrene	0.120 J					
TCL Pest	Aldrin	0.004 KJC#					
	Dieldrin	0.013 C!#					
	Endosulfan,A	0.005 JC!					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 4-20
Chemical Summary Report For Sediments
Site: P57
Units: UGG

	Site ID	E3-P57-D01					
	Field Sample ID	DXP57011					
	Sample Date	09/16/93					
Test	Parameter .						
TCL Pest	Heptachlor Epoxide	0.003 JC!					
	P,P-DDE	0.080 C#					
	P,P-DDT	0.016 JC#					
TOC	Total Organic Carbon	234000					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

5. WATERSHED 4 — UPPER ASSABET RIVER

5.1 WATERSHED DESCRIPTION AND ASSESSMENT

Proposed investigative activities for the sites identified at the Annex were determined through a review of previous activities and findings and are governed by the established SOW. The objectives of the activities were to determine whether contamination is present in groundwater, surface water, sediment, or surface/subsurface soils at the assigned Phase II sites, and, in the cases where contamination is thought or known to exist, to confirm and better characterize its nature and extent.

To evaluate each site, and to develop a better understanding of the site's impact on the Annex environment, the Annex was divided into seven distinct watersheds. In this section, the general findings of the field effort are first summarized for the watershed as a whole. Detailed information about activities undertaken and sampling results are provided for each site within Watershed 4. Conclusions and recommendations are reviewed and discussed in conjunction with the findings of the Phase I investigation conducted by OHM. Data results are provided with each site investigation report. The Appendices provide field reports, special studies, and QA/QC results to support the information presented in the text.

The sites in Watershed 4 — Upper Assabet River are shown in Figure 5-1. For ease of reference, Table 5-1 identifies each site in the watershed by number, name and status with respect to the ongoing investigation activities. Tables providing a summary of samples collected for the site, by number, type, and location are contained within the "Field Work Performed" sections of each site discussion.

Table 5-1

WATERSHED 4 SITES

Site Number	Site Name	Current Status
A6	Demolition Ground II	Site Investigation
P22	Old Gravel Pit	Site Investigation

Source: Ecology and Environment, Inc. 1994.

5.1.1 Watershed Location and Description

Watershed 4 lies in the northwest corner of the Annex. A small, unnamed stream, originating in the wetlands south of the USAF laboratory and flowing northwest and north, near the ground moraine hill on which the laboratory stands, provides primary drainage from Watershed 4 into the Assabet River just downstream of Crow Island. Much of the area

(approximately 300 acres) probably discharges directly to the Assabet or discharges indirectly through the wetlands along the river. E & E investigated two sites in this area, Site A6 and Site P22. Site A6 is built into the side of the hill and borings showed it to be underlain by clay. The clay may well extend out under the wetland adjoining Site A6 to the southwest.

Site P22 is in a very flat, sandy area formerly mined for sand and gravel with mounds of rejected material piled on the north side. Groundwater is very shallow (less than 20 feet BGS) and, judging from the flat terrain, groundwater gradients are probably very low. Refer to Section 2 for a description of aquifer characteristics. Water level measurements were collected at Sites A6 and P22 on 13 September and 3 December 1993. Average groundwater elevations presented in the Physical Characteristics section for each site are based on both sets of water level measurements. All measurements are summarized in Table 5-2 as groundwater elevations. Due to limited groundwater and subsurface data, the boundaries of this watershed are uncertain. In fact, with varying precipitation and discharge, the watershed boundaries may even move. Depth to bedrock is unknown in Watershed 4, although depth, as in much of the Annex, is probably not more than 60 to 80 feet.

Table 5-2

WATERSHED 4 — UPPER ASSABET RIVER GROUNDWATER ELEVATIONS

Site	Well	Water Levels	
		09/13/93	12/03/93
A6	E3-A06-M01	189.92	191.46
P22	E3-P22-M01	180.01	181.77

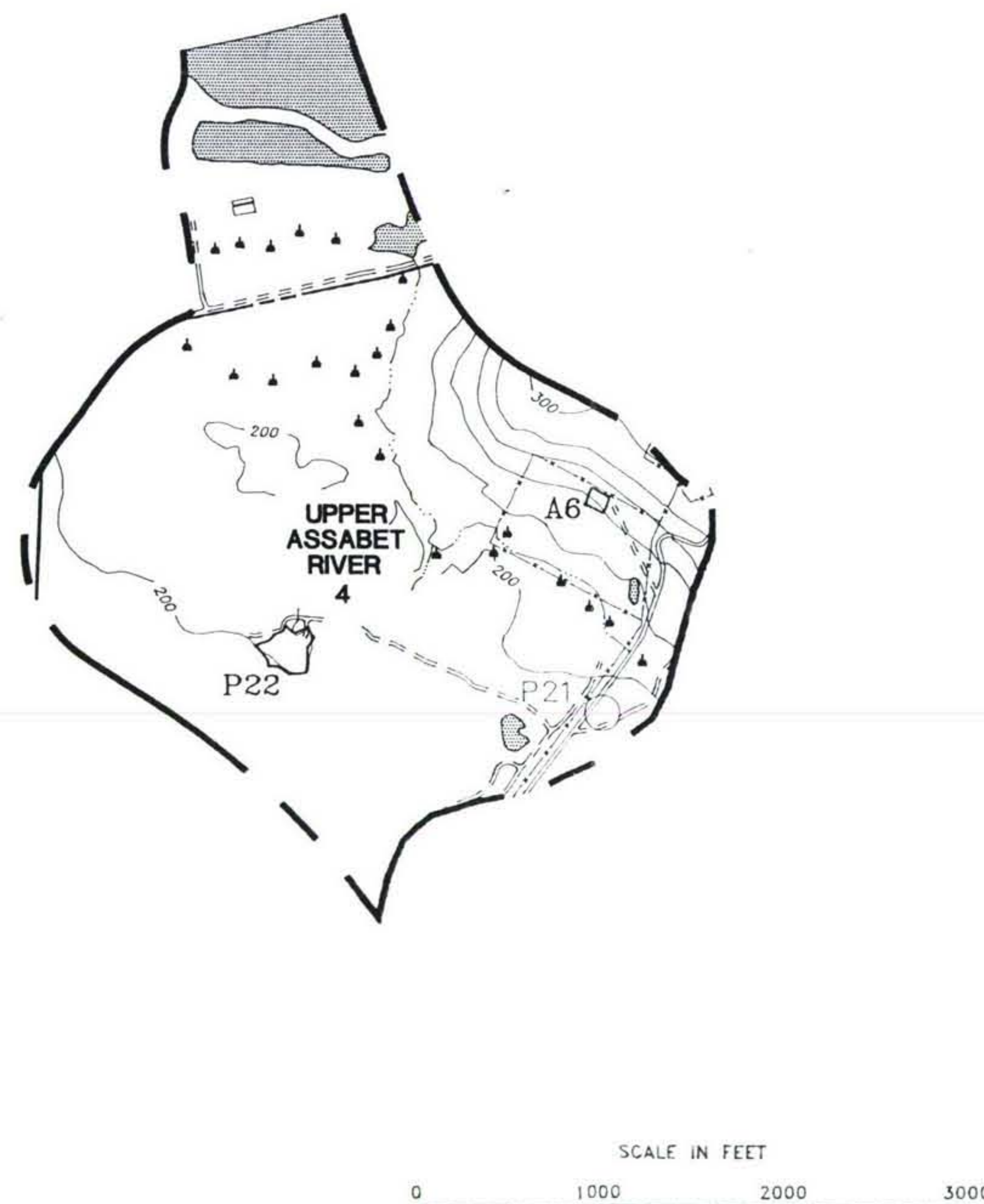
Source: Ecology and Environment, Inc. 1994.

5.1.2 Preliminary Watershed-Wide Assessment

The watershed approach that has been adopted divides the Annex into areas draining to particular streams of surface water bodies, both by surface runoff (which is minimal at the Annex) and by groundwater flow. Within each watershed, the individual sites are potential sources of contaminants and the surface water and sediments are potential receptors or sinks. Movement of water through the Annex and the discharge of groundwater to surface water transports contaminants from the soil to groundwater and then to surface water and sediments. Sediment layers are often organic-rich with high TOC that can adsorb contaminants occurring in groundwater before they reached surface water. Any persistent toxics present in the groundwater discharge can accumulate in sediments and in biota living in the streams and ponds. The result is that the cumulative impact of all sites within a given watershed tends to be concentrated in the sediments within the surface water draining the watershed and in surface water itself.

UC6S036B

WATERSHED 4 E&E SITES	
SITE NUMBER	SITE NAME
A6	DEMOLITION GROUND II
P22	OLD GRAVEL PIT



LEGEND:

- APPROXIMATE WATERSHED BOUNDARY
- BUILDING/STRUCTURE
- PAVED ROAD
- UNIMPROVED ROAD
- WATER BODY
- PERENNIAL STREAM
- INTERMITTENT STREAM
- FENCE
- INSTALLATION BOUNDARY
- 200 CONTOUR (25' INTERVAL)
- WETLAND
- **P26 E&E SITE NUMBER IN BOLD**
- P12 OHM SITE NUMBER

ecology and environment

Figure 5-1 WATERSHED 4 – UPPER ASSABET RIVER

Analysis of sediment and surface water sampling at the Annex along a given drainage may lead to findings where discharges from specific sites enter the surface water pathways. Samples taken at the point where drainages leave the Annex or join a larger stream allow an assessment to be made of the cumulative impact of a particular watershed. Sampling results were compared to background pond and stream levels and also to preliminary screening values. Surface water screening values include water quality criteria regarding both human health and aquatic life, while sediment screening values are ecologically-oriented. Surface water and sediment sampling results were also compared to site-specific groundwater and soil sampling results to attempt to identify potential sources of watershed contamination. Sampling results from previous investigations by Dames and Moore in 1984 and 1985, OHM in 1992 and 1993, and E & E in 1993 and 1994 have all been considered in the watershed assessments. The number of samples used for analysis of particular contaminants will vary depending on the varying analyte spectrum for each sample used in this assessment. Table 5-3 below lists the surface water and sediment samples considered in the watershed assessment.

Table 5-3

SURFACE WATER/SEDIMENT SAMPLE LOCATIONS IN WATERSHED 4*

Sample ID	Location
E3-A6-D01	Tributary to Assabet River, south of Site A6, west of Patrol Road.
A6SD1/SW1	Tributary to Assabet, south of Site A6, downstream of E3-A6-D01.
E3-A6-D02	Tributary to Assabet, southwest of Site A6, downstream of A6SD1/SW1.
E3-BCK-D02	Tributary to Assabet, northwest of Site A6 and Site P22, outside Annex fence, just upstream of entry into Assabet (Track Road sample).

*From upstream to downstream.

Source: Ecology and Environment, Inc. 1994.

Only three sites are located within Watershed 4. No evidence of contamination has been found regarding Site P21, and thus, the only sites considered in this watershed assessment are Site A6 (Demolition Ground II) and Site P22 (Old Gravel Pit). Groundwater discharge and surface runoff from these two sites could enter a small drainage channel which flows westward and then turns north prior to entering the Assabet River at Track Road. Wetland areas are located along most of this drainage, particularly in the northwest portion of the watershed.

5.1.2.1 Water Quality and Sediment Conditions

Given that Watershed 4 is located almost entirely on the Annex, no samples were taken to characterize background conditions for this watershed. Thus, the sampling results at several other background streams at the Annex were used for comparison purposes. Water quality parameters were only taken at the E3-BCK-D02 sample point in the Watershed 4

drainage at Track Road. At the time of sampling (22 September 1993), the pH was 6.50, and the turbidity (50 NTUs) was relatively low. Organic carbon content of sediment samples taken in Watershed 4 were relatively low, ranging from 25,500 μg/g (2.5 percent) to 60,600 μg/g (6.06 percent).

5.1.2.2 Watershed 4 Drainage

Two surface water samples were collected in Watershed 4, one (A6SW1) in the drainage downgradient of Site A6 and a second (E3-BCK-D02) just upstream of the outlet of this drainage into the Assabet River. Arsenic (4.18 μg/L), iron (2,960 μg/L, estimated), and lead (8.57 μg/L) were found in the surface water sample at Track Road above screening levels. Arsenic was slightly above the highest levels in background streams at the Annex, but iron and lead were below background levels.

Four sediment samples were collected in Watershed 4. Three of these samples were taken from the drainage south of Site A6, and the fourth was taken at Track Road before the outlet of the drainage into the Assabet. Analysis of the three sediment samples taken downgradient of Site A6 did not indicate any metals in concentrations above background and screening levels. Several pesticides, including dieldrin (0.005 μg/g), DDT (0.005 μg/g), DDD (0.124 μg/g), and DDE (0.031 μg/g) were found in concentrations above screening levels. These concentrations were also compared to EPA and NYSDEC SQC that were adjusted for the TOC content (60,600 μg/g or 6.1 percent) of the sediment sample where the highest detections of pesticides were found (E3-A06-D01). The only pesticide that exceeded these adjusted criteria was DDD (0.124 μg/g) above the NYSDEC SQC of 0.061 μg/g.

In the sediment sample taken at Track Road (E3-BCK-D02), several pesticides, lead, and TPHC were found in concentrations above background and screening levels. DDT (0.045 μg/g), and DDE (0.036 μg/g) were found at levels higher than in upstream samples. Endrin aldehyde (0.004 μg/g) and DDD (0.085 μg/g) were also found in this sample above screening levels. Lead (34.0 μg/g in the sample and 37.0 μg/g in the duplicate) was also found in this sample above background and the screening level of 31 μg/g (Ontario MOE LEL). TPHC were found in this sample (482 μg/g in the sample and 1,200 μg/g in the duplicate). The combination of lead and petroleum hydrocarbons may indicate runoff of petroleum products containing lead into the sediments beside Track Road.

5.1.2.3 Summary

The sites in Watershed 4 do not appear to have any impact on surface water or sediments. No compounds were detected above background and screening levels in surface water samples taken in the watershed. Low levels of pesticides, probably related to general past pesticide management practices at the Annex, or in the area along Track Road and at Crow Island, were found in sediment samples in this drainage basin. Lead and TPHC were found above screening levels only in the sediment sample taken at Track Road, probably indicating some very limited impact from road runoff. Lead (up to 180 μg/g) was found in several soil samples at Site P22 at concentrations slightly above the highest levels in background soils (150 μg/g), but below the soil screening level of 300 μg/g (MCP

GW–1/S–1). However, this lead in soils at Site P22 is not likely to be related to the lead found in sediments at Track Road, given that lead was not found above the detection limit in groundwater samples at Site P22, and the considerable distance (over 1,600 feet) from Site P22 to Track Road. None of the other compounds found in sediments in Watershed 4 were found above in groundwater or soil samples taken at Site A6 and Site P22 above screening levels. Table 5-4 summarizes the compounds found above background and screening levels in Watershed 4. The data for surface water and sediment sampling at E3-BCK-D02 are presented at the end of this assessment, in Tables 5-5 and 5-6, as they are not presented elsewhere in this report.

5.1.3 QA/QC Program Analysis of Results for Watershed 4

This section provides a summary of the results of the QA/QC review performed using the protocol described in Volume I, Section 5.3.3.

Data for Watershed 4 were evaluated for usability by reviewing laboratory and field QC sample data for contamination possibly introduced into field samples by either sampling or analysis procedures. First, method blanks were reviewed for each analyte in the lots associated with Watershed 4, followed by trip blanks and then rinsate blanks. Following consideration of laboratory and field QC blank samples data, laboratory flagging codes and USAEC data qualifiers were evaluated with laboratory control charts for each lot to assess potential analytical QC problems. Analytical results were then reviewed for precision and accuracy through consideration of the RPD between each sample/duplicate pair and MS/MSD sample set and spike and surrogate recoveries.

A discussion of samples for each study area affected qualified as part of the QA/QC evaluation. Samples with contamination also found in the blank were qualified either with a "B" usability code for "present in the blank" or a "K" usability code for a result-biased high. Samples considered to have QA/QC problems were qualified with a "J" usability code for estimated, an "L" usability code for a result-biased low, or "R" for rejected. Appendix F provides a list of all QC summary data for method blanks, trip blanks, rinsate blanks, field duplicate samples, and MS/MSD samples.

Table 5-4

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS FOR SURFACE WATER AND SEDIMENT IN WATERSHED 4

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	High Conc.	Sample ID of Highest Concen-tration	Above Background and Screen Level	
							Locations Found	Frequency
SW (μg/L)	Arsenic	3.15	0.018	MA/CWA WQC[1]	4.18	E3-BCK-D02	At Track Road	1/2(Bck) 0/2(Both)
	Iron	4,810	1,000	MA/CWA WQC[2]	2,960	E3-BCK-D02	At Track Road	1/2(Bck) 0/2(Both)
	Lead	10.3	3.2	MA/CWA WQC	8.57	E3-BCK-D02	At Track Road	1/2(Bck) 0/2(Both)
SED (μg/g)	Lead	4.48	31	Ontario MOE LEL[3]	37.0	E3-BCK-D02	At Track Road	1/4
	α-chlordane	---	0.005	NOAA ERL[4] (chloride)	0.001	E3-A06-D01	Stream SW of A6	1/4
	Dieldrin	---	0.00002	NOAA ERL	0.005	E3-A06-D01	Stream SW of A6	2/4
	DDD	--	0.002	NOAA ERL	0.124	E3-A06-D01	Stream SW of A6 At Track Road	3/4
	DDE	---	0.002	NOAA ERL	0.036	E3-BCK-D02	Stream SW of A6 At Track Road	3/4
	DDT	---	0.001	NOAA ERL	0.045	E3-BCK-D02	Stream SW of A6 At Track Road	3/4
	Endrin Aldehyde	---	0.00002	NOAA ERL (Endrin)	0.006	E3-BCK-D02	At Track Road	1/4
	TPHC	16.6	2	Ontario MOE LEL	1,200	E3-BCK-D02		1/1

[1]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for protection of human health re: consumption of water and fish.
[2]MA/CWA WQC = Massachusetts Clean Water Act Water Quality Criteria for protection of aquatic life.
[3]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[4]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.

Source: Ecology and Environment, Inc. 1994.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 5-5
Chemical Summary Report For Facility Wide Surface Water Samples
Site: BK2
Units: UGL

Test	Parameter	E3-BCK-D02		E3-BCK-D02					
	Field Sample ID	WDBCK021		WXBCK021					
	Sample Date	09/22/93		09/22/93					
TAL METAL	Aluminum	833	J!	328	J				
	Arsenic	4.18	!@	2.56	@				
	Barium	15.3	J!	13.7	J!				
	Calcium	3920		3750					
	Chromium	2.68	J	< 10.0					
	Cobalt	3.05	J	< 10.0					
	Copper	2.95	J	< 10.0					
	Iron	2960	J#	1500	J#				
	Lead	8.57	#	6.01	#				
	Magnesium	1380		1310					
	Manganese	235	!	211	!				
	Potassium	1410		2140	!				
	Sodium	4440		4680					
	Vanadium	4.86	J!	< 10.0					
	Zinc	53.0	!	44.1	!				
TCL BNA	Bis(2-ethylhexyl)phthalate	1.00	J	0.850	J				
	Hexadecanoic Acid	5.90							
WQP	Phosphorus, Total	150	J	34.0	J				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 5-6
Chemical Summary Report For Facility Wide Sediment Samples
Site: BK2
Units: UGG

	Site ID	E3-BCK-D02	E3-BCK-D02				
	Field Sample ID	DDBCK021	DXBCK021				
	Sample Date	09/22/93	09/22/93				
Test	Parameter .						
TAL METAL	Aluminum	3700	3720				
	Arsenic	4.25 !	5.86 !				
	Barium	16.8	20.4				
	Beryllium	0.118 J	0.115 J				
	Calcium	636 J!	639 J!				
	Chromium	10.6 !	9.16				
	Cobalt	4.21 !	4.70 !				
	Copper	9.25 !	7.65 !				
	Iron	6730	6430				
	Lead	37.0 J!#	34.0 J!#				
	Magnesium	1690	1590				
	Manganese	63.4	66.5				
	Nickel	7.59 !	7.42 !				
	Potassium	806	893				
	Vanadium	11.9	13.1				
	Zinc	19.0	21.9 !				
TCL Pest	Endosulfan,B	0.002 JC	< 0.002				
	Endrin Aldehyde	0.006 C#	0.004 C#				
	Heptachlor Epoxide	0.001 JC	0.001 JC				
	P,P-DDD	0.008 JC#	0.085 JC#				
	P,P-DDE	0.004 C#	0.036 JC#				
	P,P-DDT	0.010 JC#	0.045 JC#				
	gamma-Chlordane	0.001 JC#	0.001 JC#				
TOC	Total Organic Carbon	41200	27600				
TPHC	Total Petroleum Hydrocarbons	1200 !@	482 !#				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

5.1.3.1 Site A6 — Demolition Ground II

Blank contamination was found for 17 analytes in 19 samples. Alpha-BHC, α–endosulfan, aluminum, aldrin, beryllium, methylene chloride, endrin, endosulfan sulfate, potassium, lead, and zinc were found in the method blanks. Aldrin, endrin, α-endosulfan, and endosulfan sulfate were due to carryover from lab equipment. Only potassium was considered to be from the source water used to prepare the standard matrix. The other metals were considered to be also due to the inherent content of the standard matrix. Cadmium, iron, lindane, manganese, sodium, and antimony were found in the rinsate samples. In the samples, potassium results were biased high due to the rinsate blank, while sodium results were biased high due to both method blank and rinsate blank.

On review of the RPDs for the duplicate pairs, arsenic, chromium, dieldrin, DDT, and selenium were found to be outside of RPD control limits and these samples were qualified as estimated.

5.1.3.2 Site P22 — Old Gravel Pit

Blank contamination was found for 20 analytes in 11 samples. Aldrin, bis-2 ethylhexyl phthalate, beryllium, methylene chloride, endrin, endosulfan sulfate, potassium, lindane, sodium, lead, and zinc were found in method blanks. Aldrin, endrin, endosulfan sulfate and lindane were due to carryover from lab equipment. Potassium, lead, zinc, and sodium were due to water used to process the blanks. Aluminum, iron, manganese, antimony, cadmium, and carbon disulfide were found in rinsate samples. The presence of the metals was probably due to particulates washed from the sampling equipment. Carbon disulfide is a laboratory artifact.

Three samples were biased high due to method blank contamination. DDT and endrin were found at levels within 10 times the blank level and the associated sample results were qualified as "K", and sodium and antimony also were qualified as "K" due to rinsate blank contamination.

Review of the RPDs for the duplicate pair found that only β-endosulfan was outside of the RPD control limits for the duplicates (SDP22011/SXP22011), and these samples were qualified as estimated.

5.2 SITE DISCUSSIONS

5.2.1 Site A6 — Demolition Ground II

Site A6 was identified by USATHAMA in 1980 after review of an undated facility map (probably from the MOTS period 1952 to 1957) that indicated an explosives testing area at the site (USATHAMA 1980). Figure 5-2 presents a site map.

5.2.1.1 Site Location

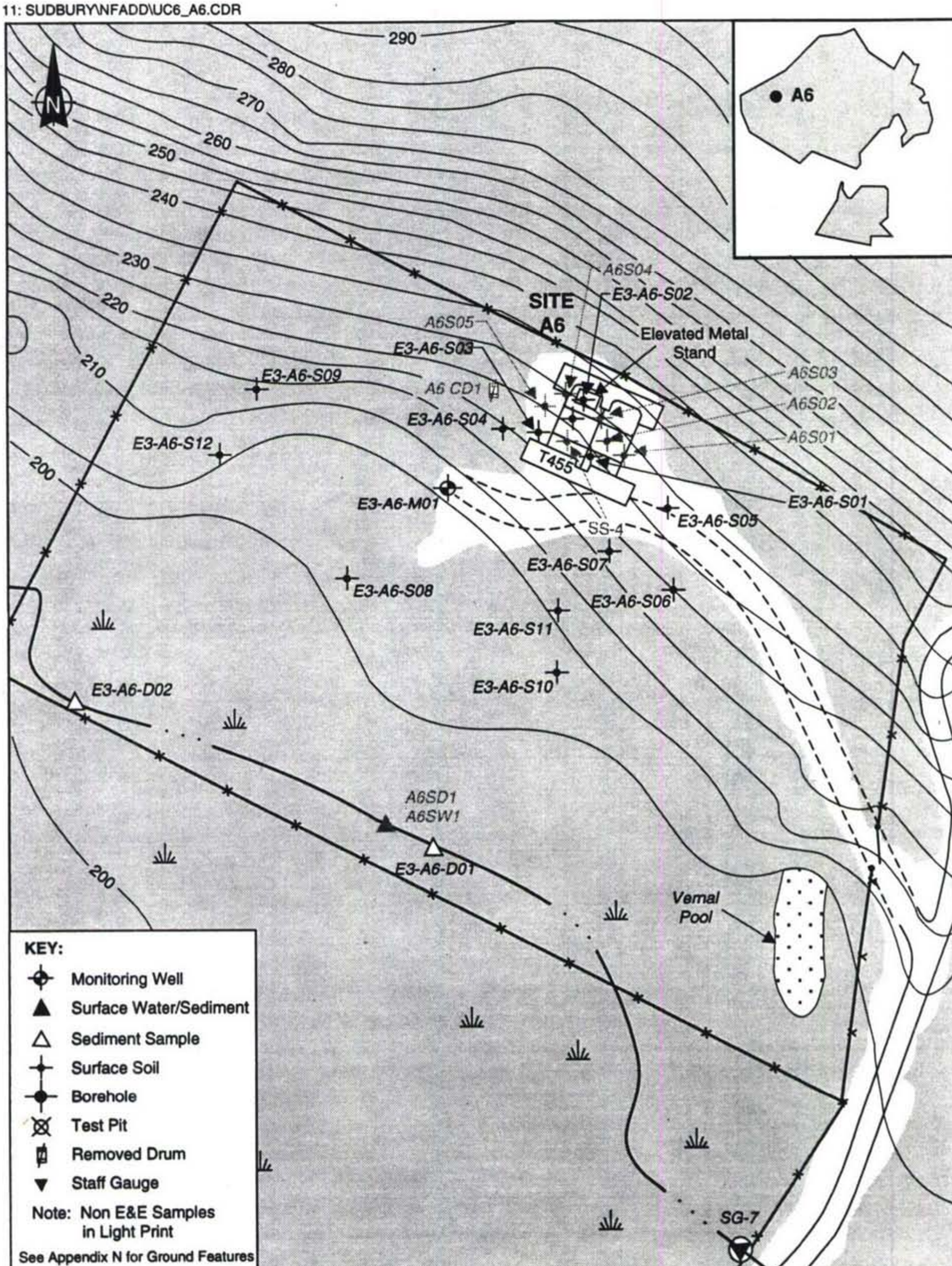
Site A6 lies in a forested area on the northwestern corner of the Annex approximately 400 feet southeast of the USAF Weather Science Radar Laboratory. Access to Site A6 is through a gate, which is usually kept locked, by means of an unpaved road diverging northwest from Patrol Road. Approximately 550 feet down the unpaved road, there is a clearing. In the center of the clearing is a soil mound overgrown by brush. Between this mound and the hillside just north of it, there is a large concrete structure composed of two parallel concrete walls joined by a metal grid above. One of the walls stands against the hillside while the other rests against the soil mound. In the wall against the hillside, there are two semicircular compartments approximately 15 feet in diameter lined with metal sheets. In the western semicircular compartment there is a rusted metal staging area standing on four supports. To the south of the concrete wall structure and the soil mound there is a small clearing with sparse vegetation.

5.2.1.2 Physical Characteristics

Site A6 is located on the southwest slope of a ground moraine or hill of glacial till. Surface elevations across Site A6 range from 200 to 245 feet AMSL. Average groundwater elevation, as estimated from measurements collected at monitoring well E3-A6-M01, is 190 feet AMSL.

A single monitoring well (E3-A6-M01) was installed at Site A6 by E & E in 1993. Bore logs from this location show a sand and silt mixture with some gravels extending from 0 to 10 feet BGS. This stratum is indicative of an outwash or alluvial environment. Glacial till consisting of a dense sand, silt, clay, and gravel mixture was encountered from 10 to 21 feet BGS. The total depth of the boring at E3-A6-M01 was 21 feet. A soil sample collected from the 13.5-to-15.5-foot interval of the boring was submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as non-plastic, silty sand. Additional grain size and Atterberg limits analyses were performed on surface soil sample E3-A06-S01 and on sediment samples E3-A06-D01 and E3-A06-D02. The surface soil was identified as a non-plastic, well-graded sand with silt. Both sediment samples were identified as silty sand; however, sample E3-A06-D02 was determined to have a low plasticity (liquid limit less than 35) while sample E3-A6-D01 was determined to be non-plastic. Appendix D contains a complete summary of geotechnical laboratory results.

11: SUDBURY\NFADD\UC6_A6.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 5-2 MAP OF SITE A6 DEMOLITION GROUND 2

Bedrock was not encountered during subsurface exploration and depth to bedrock is unknown. The underlying bedrock material is projected to be Gospel Hill Gneiss (Hansen 1956).

A slug test was attempted by E & E in 1993 at monitoring well E3-A6-M01; however, due to insufficient water within the well, the slug test was not possible. No aquifer transmissivity was calculated for this area, but it would clearly be very low in these materials.

Surface water flows south-southwest from Site A6 to an adjoining wetland. A small intermittent stream drains the wetland northward into the Assabet River. Using water levels observed at E3-A6-M01 and in the adjoining wetland, and area topography, groundwater flow at Site A6 appears to be south-southwest to the adjacent wetland.

5.2.1.3 Ecological Characterization

Site A6 is located in a forested area on the northwestern corner of the Annex approximately 400 feet southeast of the USAF Weather Science Radar Laboratory. Except for the cleared area adjacent to the dirt access road and Building T455, most of the site is vegetated with white pines and oak trees ranging from 40 to 60 feet in height. Approximately 250 feet south of the site, there is a dense growth of tall (over 60 feet in height) white pines (LFS 1983).

Based on the topography of the area, both surface and groundwater runoff flows southwest and discharges to a wetland located approximately 250 feet away (E & E 1994). This large, seasonally saturated wetland is vegetated with deciduous trees and extends north to the Assabet River. Located approximately 1,200 feet south of the site, there is a small, intermittently exposed pool with a sandy bottom that may be hydrologically connected to the wetland below the site (Butler 1992). Three hundred feet southeast of the site there is an oblong 90 by 60 foot, vernal pool, six feet deep, referred to as the Radio Facility Pool (Butler 1992) that is connected hydrologically to the wetland below the site.

The combination of upland wooded areas, wetlands, and vernal pools make this area valuable to wildlife. Pine seeds and acorns, twigs, needles and leaves on the site are frequently eaten by small mammals, songbirds, upland gamebirds, and deer (Martin *et al.* 1951). In addition, the dense canopy serves as excellent cover for many species during the winter. Oak tree leaves create a thick mat underneath which reptiles and amphibians can find shelter and food. Open bodies of water, such as the Radio Facility Pool, provide drinking water, food, breeding areas, and shelter for many species of reptiles, amphibians, waterfowl, and upland species such as deer. The extensive forested wetland located to the south and southwest of the site combines an abundance of nutrients, the presence of diverse woody species, and the availability of water. Consequently, this area is expected to attract a diverse array of aquatic species, upland species, as well as species specifically adapted to wetlands.

No federally-listed species have been documented in the vicinity of the site. However, the spotted salamander (*Ambystoma maculatum*), a state watch-list species, was seen in the Radio Facility Pool. This pool is also considered to be a suitable habitat for a state

listed special concern species, the blue-spotted salamander (*Ambystoma Laterale*) (Butler 1992). In addition, a population of small beggar-tick plants (*Bidens discoidea*), a state watch-list species, was noted approximately 1,200 feet southeast of the site (Hunt 1992). No unique habitats are known to occur near the site (NHESP 1992).

5.2.1.4 Site History

Site A6 consists of two reinforced concrete stalls used for the testing of ammunition and explosives. This activity took place in a structure known as Building T455, constructed sometime after World War II. It is likely that Building T455 was built around 1952, as part of the general construction effort conducted to meet ordnance research and development needs. Building T455 does not appear on historic facility maps for 1942, 1944, or 1946. An undated map located by USATHAMA in 1980 (probably from the MOTS period from 1952 to 1957) identified Site A6 as "Test Area No. 2, Explosives, 8-pound limit." Building T455 is present on a 1955 facility map and is labelled "Demo No. 2." Additional nearby structures at the time included Building T459, located west of Buildings T455 and T456 near Patrol Road. Building T456 was built as a personnel bunker. Building T459 was demolished sometime around 1960. The exact nature of explosives testing conducted during the MOTS period could not be identified due to a general lack of information for that period.

Site A6 was apparently used throughout the 1960s as a pistol range. A 1962 facility map noted a pistol range located immediately west of Building T455. Natick Real Estate records from 1967 noted that the area had also been used by security and military police as a small arms range.

Explosives testing was also conducted at Site A6 in the late 1970s by the Army Materials and Mechanics Research Center (AMMRC) of Watertown, Massachusetts. Permission was granted in 1975 to AMMRC to store explosives and conduct tests in "the bunkers provided." AMMRC was assigned Bunkers 337 and 340 in 1973, and Bunkers 324 and 347 in 1977.

In May 1977, AMMRC received permission to use Building T455 for outdoor explosives testing. AMMRC had requested use of the site to detonate thin-walled cylinders containing up to 5 pounds of Class 7 explosives in air and under water. This testing was intended to examine the use of a "slapper" device in a 105 mm shell, and involved velocity and fragmentation studies. The explosive used in 105 mm shells is C-4. Explosives brought from Bunker 347 were detonated with electric blasting caps. Open air testing was performed by placing (and then detonating) the explosive approximately 2 feet below the center of the metal table located within the concrete walls of Building T455. Fragmentation studies were also conducted underwater in a 1,000-gallon metal tank, which was recessed in the ground in front of the steel table. Water was to be obtained from a well drilled in an area adjacent to the testing area. It is unknown if this well was ever drilled as it has not been located at the site and no records note the event.

The dates of use of Building T455 by AMMRC have not been confirmed. A 1977 bunker survey noted that AMMRC was storing testing equipment in Bunker 324 and

explosives in Bunker 347. Bunker 324 contained two large, rusty, metal vats at the time of a 1992 bunker survey. These may have been the metal tanks used for underwater explosive testing at Site A6.

5.2.1.5 Results of Previous Investigations

Investigations performed at Site A6 through mid-1992 are summarized in Section 7.5 of the January 1994 *Final Site/Remedial Investigation Report* (OHM 1994). Previous investigations have attempted to localize and characterize potential contamination resulting from explosive testing activities conducted at this site.

In 1984, Dames and Moore collected one surface soil sample from the area between the two concrete walls. No nitroaromatic explosives were detected. Only lead (102 μg/g), and total phosphate (500 μg/g) were identified in the sample (Dames and Moore 1986a).

In 1992, OHM conducted several investigative activities at Site A6. An area reconnaissance located an empty drum on the western side of the building and a few pieces of scrap metal. The scanner magnetic study located several more miscellaneous pieces of scrap metal but showed no evidence of buried metals.

Five surface soil samples and one drum confirmation sample were collected around the concrete structures. DDT (0.04 μg/g) residues were present in four out of six surface soil samples. The pesticide Lindane (0.034 μg/g) was also found in one sample (E3-A6-S05). Two of the six samples were reported by OHM to contain phosphate (1.73 μg/g). The PAH benzo(*a*) anthracene (2.0 μg/g) and fluoranthene (1 μg/g) were found in sample E3-A6-S03. All six samples contained elevated concentrations of copper (580 μg/g, maximum) as compared to off-site background soils. Nickel (246 μg/g) and cobalt (390 μg/g) were high in sample E3-A6-S04. In comparison to background soil, an elevated amount of cobalt (13.4 μg/g) was found in sample E3-A6-S05. Lead (150 μg/g) was found in sample E3-A6-S05.

Surface water and sediment samples collected from the marshy area west of Building T455 did not contain any pesticides/PCBs, explosives, or phosphates.

Removals

The empty drum discovered by OHM on the western side of Building T455 was removed and staged at the Temporary Drum Storage Area near Site P13.

Drum Confirmation Sample A6CD1 contained PCB 1254 (0.204 μg/g). Mercury (1.4 μg/g) was also found in the sample, which is the highest mercury concentration found in soil at the Annex to date.

5.2.1.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL pesticides/PCBs, TAL metals, and explosives. In addition, surface soil samples, sediment samples, and subsurface soil samples were also sampled for TOC and grain size. The Phase II sampling effort activities for Site A6 are summarized in Table 5-7.

Table 5-7

PHASE II SAMPLING EFFORT AT SITE A6 — DEMOLITION GROUND II

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	2	08/26/93 12/02/93	Samples were collected to characterize groundwater contamination and assess the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	1	08/06/93	Geotechnical sample was collected and sent for grain size and Atterberg Limit analyses to investigate the nature of the subsurface soils on site.
	1	08/06/93	Sample was collected and sent for TOC analysis to provide further data on the nature of subsurface soils.
Surface Soils	12	09/14/93	Samples were collected to investigate surface contamination and assess the potential of surface soils to act as future contaminant sources.
	1	09/14/93	Sample was collected from location E3-A06-S01 and sent for TOC analysis to provide data on the nature of surface soils on site.
	1	09/14/93	A geotechnical sample was collected to further characterize the nature of soils.
Sediments	2	09/14/93	Samples were collected to investigate streambed contamination and the impacts of surface runoff and groundwater discharge from the site on the surface water pathway.
	2	09/14/93	Geotechnical samples were collected and sent for grain size and Atterberg Limits analyses to provide data on the nature of the streambed sediments and their impact upon contaminant migration through the surface water pathway.
	2	09/14/93	Samples were collected and sent for TOC analysis to provide further data on the nature of streambed sediments and their impact upon the surface water pathway.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

In order to characterize groundwater quality downgradient of the demolition and explosives testing area, E & E installed, developed, and sampled one shallow overburden monitoring well, E3-A06-M01. The well was screened across the water table at an interval 9 to 19 feet BGS. Well E3-A06-M01 was sampled during both rounds of groundwater

sampling in August and December 1993. Both filtered and unfiltered samples were collected during each round for TAL metals.

Two downgradient monitoring wells were originally planned for Site A6. During drilling of the second well, however, an unusually tight and thick band of clay was encountered below a layer of till. This combination of geological features produces a very low hydraulic conductivity and minimal water was encountered in the borehole during drilling. To evaluate the feasibility of installing a well at this location, the borehole was left overnight. When it was inspected the following day, less than one foot of groundwater had accumulated over a 12-hour period. Based upon this relatively low groundwater recharge rate, the decision was made to discontinue well installation and the borehole was properly abandoned.

After consultation with USAEC, an additional decision was made to collect two sediment samples from the wetland stream downgradient and south of the site. These additional samples offset the loss of groundwater data from the second well and provided means to characterize on-site contamination and the potential for contaminant migration through surface runoff pathways.

Subsurface Soil Sampling

During monitoring well installation, geotechnical samples were collected from the screened interval and sent for grain size analysis. An additional sample was also collected from the screened interval at well E3–A6–M01 and sent for TOC analysis. These samples provided data on the nature of the subsurface soils in the area and their possible impact on contaminant migration in the groundwater pathway.

Surface Soil Sampling

Surface soil samples were collected from 12 locations in and around the demolition and testing area at Site A6. The samples were collected to assess site surface contamination and the nature of the surface soils surrounding the ammunition testing area. The samples were collected from areas with obvious discoloration, stressed vegetation, or in surface drainage channels. In addition, one surface soil sample was collected from location E3–A06–S01 and sent for TOC analysis. A second sample collected at the same location was sent for grain size analysis to provide further data on the nature of surface soils in Site A6.

Sediment Sampling

Two sediment samples were collected from the intermittent stream approximately 250 feet south of the ammunition demolition and testing area. The stream flows in a northwesterly direction eventually converging with the Assabet River to the north. The samples were collected in areas where sediments had accumulated. Sample location E3–A06–D01 lies due south of the demolition area and approximately 75 feet further upstream than location E3–A06–D02. At each location, samples were collected and sent for grain size and TOC analyses. The samples provide data on the nature of the streambed sediments and the impacts of contaminant migration in the surface water pathway.

5.2.1.7 Nature and Extent of Contamination

The initial concern at Site A6 was that explosive testing activities in Building T455 may have resulted in contamination of surrounding media. Groundwater, surface soil, and sediment sampling at this site did not identify any evidence of site-related contamination. A summary of detection limits above preliminary screening levels for the site is presented in Table 5-8. Analytical results of samples collected at Site A6 are provided after this section in Tables 5-9 through 5-12.

Table 5-8

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE A6

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1] Aluminum(F)[2]	--- ---	50	MA SMCL[3]	48,000 *	E3-A06-M01 E3-A06-M01	1/1 0/1
	Chromium(U) Chromium(F)	--- ---	100	SDWA MCL[4]	116 < 10.0	E3-A06-M01 E3-A06-M01	1/1 0/1
	Iron(U) Iron(F)	--- ---	300	MA SMCL	68,000 < 25.0	E3-A06-M01 E3-A06-M01	1/1 0/1
	Manganese(U) Manganese(F)	--- ---	50	MA SMCL	889 153	E3-A06-M01 E3-A06-M01	1/1 1/1
SOIL (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[5]	0.674	E3-A06-S10	4/12
SED (μg/g)	α-chlordane	---	0.0005	NOAA ERL[6] as chlorine	0.001	E3-A06-D01	1/2
	Dieldrin	---	0.00002	NOAA ERL	0.005	E3-A06-D01	2/2
	DDD	---	0.002	NOAA ERL	0.124	E3-A06-D01	2/2
	DDE	---	0.002	NOAA ERL	0.031	E3-A06-D01	2/2
	DDT	---	0.001	NOAA ERL	0.005	E3-A06-D01	2/2

*No value reported for either round due to laboratory contamination.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
[5]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[6]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range Low.

Source: Ecology and Environment, Inc. 1994.

Analysis of an unfiltered sample from the newly installed well (E3-A06-M01) indicated aluminum, chromium, iron, and manganese above groundwater screening levels. Aluminum, iron, and manganese were found above the Massachusetts Secondary MCLs, and chromium (116 μg/L) was slightly above the SDWA MCL 100 μg/L. In the filtered sample, concentrations of all metals dropped significantly, indicating that the higher levels in the unfiltered samples are probably the result of suspended solids. Iron and chromium were not detected above the reporting limit in the filtered samples. Manganese was detected in one

filtered sample above screening levels. The concentration of manganese (153 μg/L) in this sample was above the Massachusetts SMCL of 50 μg/L. Nitrate (272 μg/L) was detected in the groundwater sample at a concentration well below the screening level of 10,000 μg/L (SDWA MCL). No pesticides, explosives or PCBs were detected in groundwater sampling.

Unfiltered samples were collected from the well previously used by the USAF for their facility at the top of the hill above Site A6. This well was also used as the source of USAEC approved water used for decontamination of field equipment. Analysis of the sample drawn from this well indicate results similar to that for the filtered sample taken at the Site A6 well with the exception of manganese. Manganese was detected above the Massachusetts SMCL in the well at Site A6, but was found at 1.89 μg/L in the USAF well, possibly attributable to laboratory or field contamination. The different results are probably due to differences in the surrounding media at the two wells, and are not thought to indicate site related contamination.

In analysis of twelve soil samples taken at this site, the only compound found at a concentration above soil screening levels was beryllium. Beryllium was found at a maximum of 0.674 μg/g, which is slightly above the soil screening level of 0.4 μg/g (MCP GW-1/S-1) and the maximum concentration found in background soils (0.446 μg/g). However, this level was well below the MCP GW-3/S-3 value of 3 μg/g and is considered to reflect naturally occurring levels. The highest concentrations of other metals were found above background levels, including lead (250 μg/g, maximum), chromium (21.0 μg/g, maximum), but none were found above soil screening levels.

Pesticides were found in some of the soil samples, but most were below the maximum background levels in soils. All pesticide concentrations were found below soil screening levels. The highest concentration of pesticides found above background in some of the samples included β-endosulfan (0.002 μg/g), DDT (0.760 μg/g), DDE (0.760 μg/g), and DDD (0.160 μg/g). The presence of pesticides at low levels in soil at this site is not believed to be site related and is likely to be related to historic pest management practices in the past at the Annex. No PCBs were detected in soil samples.

Analysis of two sediment samples taken downgradient of the site indicated several metals above background levels and several pesticides above lowest-effect levels for benthic organisms for sediments. None of the metals detected were above sediment screening levels. Pesticides found above sediment screening levels included α-chlordane (0.001 μg/g), dieldrin (0.005 μg/g), DDT (0.005 μg/g), DDD (0.124 μg/g), and DDE (0.031 μg/g) at levels above the NOAA ERL levels for these pesticides. These concentrations were also compared to EPA and NYSDEC SQC that were adjusted for the TOC content (60,600 μg/g or 6.1 percent) of the sediment sample where the maximum concentrations of pesticides were found at E3-A06-D01. The only pesticide concentration that exceeded these adjusted criteria was DDD (0.124 μg/g) above the NYSDEC SQC of 0.061 μg/g. No explosives or PCBs were detected in sediment samples.

5.2.1.8 Conclusions and Recommendations

The results of previous and recent sampling indicate that the history of explosive testing at Site A6 has not had an impact on groundwater, soil, or sediment at the site or downgradient, with the exception of a small area of soil with residual PAHs immediately adjacent to the metal structure at the center of the site identified by OHM in the SI. No significant concerns were raised by the results of E & E groundwater, soil or sediment sampling. No explosives were found in groundwater, soil, or sediment. No explosives were observed in previous samples of sediments, surface water and soils collected by OHM in 1992, or in soils by Dames and Moore in 1984.

Some low levels of pesticides were found in soil and sediment samples collected by E & E, but not in groundwater. These results are similar to investigation results in other locations at the Annex and probably reflect general past pesticide management practices. No PCBs were detected in groundwater, soil, and sediments samples collected by E & E.

Previous soil sampling by OHM in the immediate area of explosives testing had indicated elevated levels of metals including cobalt, copper, nickel, and lead. The amounts of copper, nickel and lead were all below soil screening levels used in this study, and no screening levels could be found for cobalt. DDT (0.04 μg/g, maximum) and lindane (0.034 μg/g) were also found at trace concentrations below soil screening levels. Two PAHs, benzo(*a*)anthracene (2.0 μg/g) and fluoranthene (1 μg/g) were found by OHM in a sample (A6S03) taken near the metal structure where explosive testing was conducted. The concentrations of benzo(*a*)anthracene was slightly above the soil screening level of 0.7 μg/g (MCP GW-1/S-1 soil value). PAHs, benzo(*a*)anthracene (0.4 μg/g), were only found in one other sample taken by OHM, indicating a very limited area affected by PAHs. OHM removed a drum that had been located west of the site, and found mercury (1.4 μg/g) and PCB 1254 (0.204 μg/g) in soil samples. These concentrations were below the soil screening levels used in this study for mercury of 10 μg/g (MCP GW-1/S-1) and for PCBs of 2 μg/g (MCP GW-1/S-1).

A small area with low residual levels of PAHs at the center of the site is the only impacted area of this site, due to explosive testing. Given that there is no evidence of explosives, pesticides, heavy metals, or PCB contamination at this site, and that the PAHs detected were only found in a small area at relatively low levels, any potential risk at this site is likely to be extremely low. No further action is recommended at this site.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 5-9
Chemical Summary Report For Groundwater
Site: A06
Units: UGL

	Site ID	E3-A06-M01	E3-A06-M01	E3-A06-M01	E3-A06-M01	USAF	
	Field Sample ID	MFA06011	MFA06012	MXA06011	MXA06012	MXBKDAF1	
	Sample Date	08/26/93	12/02/93	08/26/93	12/02/93	09/03/93	
Test	Parameter						
TAL METAL	Aluminum	20.9 BJ	20.8 BJ	48000 @	6410 @	32.4 B	
	Arsenic	< 2.00	< 2.00	7.28	4.16	1.62 J	
	Barium	10.2	6.33 J	301	46.1	< 10.0	
	Beryllium	0.127 BJ	< 5.00	2.35 J	0.244 J	< 5.00	
	Cadmium	< 5.00	< 5.00	2.95 J	1.28 J	< 5.00	
	Calcium	8770	8880	16200	10400	27200	
	Chromium	< 10.0	< 10.0	116 @	10.6	< 10.0	
	Cobalt	< 10.0	< 10.0	44.0	4.26 J	< 10.0	
	Copper	< 10.0	< 10.0	108	13.5	28.7	
	Iron	< 25.0	< 25.0	68000 @	7720 @	50.3 B	
	Lead	< 5.00	< 5.00	11.8	3.72 BJ	1.94 J	
	Magnesium	3110	3090	21200	5020	5900	
	Manganese	153 @	47.6	889 @	146 @	1.89 BJ	
	Nickel	8.83 J	< 10.0	93.4	15.3	< 10.0	
	Potassium	2260	1590	15600	3520 B	3220	
	Sodium	8500	7320 K	9680	8950 K	13400	
	Vanadium	< 10.0	< 10.0	132	12.8	3.50 J	
	Zinc	22.5 B	6.11 BJ	135	38.9	318	
WQP	Nitrate			272	339	< 100	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 5-10
Chemical Summary Report For Subsurface Soils
Site: A06
Units: UGG

	Site ID	E3-A06-M01					
	Field Sample ID	BX0601X1					
	Sample Date	08/06/93					
Test	Parameter Depth	19.0 ft.					
TOC	Total Organic Carbon	12500					

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 5-11
Chemical Summary Report For Surficial Soils
Site: A06
Units: UGG

	Site ID	E3-A06-S01	E3-A06-S02	E3-A06-S03	E3-A06-S04	E3-A06-S05	E3-A06-S06
	Field Sample ID	SXA06011	SXA06021	SXA06031	SXA06041	SXA06051	SXA06061
	Sample Date	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93
Test	Parameter .						
EXPLOSIVES	2,4,6-Trinitrotoluene	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
TAL METAL	Aluminum	6660	5570	6150	7980	10500 !	9980
	Arsenic	10.8 J!	9.14 J	8.04 J	9.47 J	8.87 J	10.6 J!
	Barium	26.4 !	21.0	23.7	28.9 !	43.5 !	41.5 !
	Beryllium	0.269 J	0.191 J	0.211 J	0.275 J	0.408 J@	0.375 J
	Calcium	794	848	628	919	1560 !	1430 !
	Chromium	15.1 J!	20.2 J!	14.2 J	17.7 J!	20.1 J!	19.8 J!
	Cobalt	17.5 !	14.7 !	13.7 !	9.96 !	9.86 !	10.0 !
	Copper	220 !	360 !	140 !	77.0 !	96.7 !	27.9 !
	Iron	20000 !	42000 !	15000 !	10600	18000 !	18000 !
	Lead	250 !	49.0	49.0	31.0	76.0	86.0
	Magnesium	2100	2080	2550 !	3420 !	3830 !	3580 !
	Manganese	171 !	347 !	198 !	269 !	377 !	242 !
	Mercury	< 0.100	< 0.100	< 0.100	< 0.100	0.111 J	< 0.100
	Nickel	23.3 !	29.0 !	18.5 !	18.4 !	18.5 !	17.7 !
	Potassium	1150 !	982 !	1350 !	1970 !	2670 !	1970 !
	Selenium	< 0.200 JL	< 0.200 J	< 0.200 J	< 0.200 J	< 0.200 J	< 0.200 J
	Sodium	146 KJ	199 KJ	114 BJ	121 BJ	283	288
	Vanadium	15.4	14.3	14.5	19.5	36.8 !	28.6
	Zinc	130 !	65.7 !	47.0 !	59.7 !	76.2 !	49.3 !
TCL Pest	Dieldrin	0.014 JC	0.005 JU	0.003 JU	0.001 JU	0.003 JU	0.004 JU
	Endosulfan,A	0.001 BJC	< 0.002	0.000 BJC	< 0.002	0.001 JC	< 0.002
	Endosulfan,B	0.006 U!	0.002 JU	0.001 JU	< 0.002	0.002 JC	0.002 JC
	Heptachlor Epoxide	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.024 U!
	Lindane	< 0.002	< 0.002	< 0.002	< 0.002	0.002 JU	0.001 JU
	P,P-DDD	0.007 C	0.003 U	< 0.002	< 0.002	0.048 C	0.160 C!
	P,P-DDE	0.003 C	0.002 JC	0.001 JC	0.004 C	0.111 C	0.760 C!

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 5-11
Chemical Summary Report For Surficial Soils
Site: A06
Units: UGG

	Site ID	E3-A06-S01	E3-A06-S02	E3-A06-S03	E3-A06-S04	E3-A06-S05	E3-A06-S06
	Field Sample ID	SXA06011	SXA06021	SXA06031	SXA06041	SXA06051	SXA06061
	Sample Date	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93
Test	Parameter .						
TCL Pest	P,P-DDT	0.004 JC	0.005 JC	0.004 JC	0.005 JC	0.190 JC	0.760 JC!
	alpha-BHC	< 0.002	< 0.002	0.000 BJC	0.001 BJC	< 0.002	< 0.002
TOC	Total Organic Carbon	17300					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

recycled paper

ecology and environment

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 5-11
Chemical Summary Report For Surficial Soils
Site: A06
Units: UGG

	Site ID	E3-A06-S07	E3-A06-S08	E3-A06-S09	E3-A06-S10	E3-A06-S11	E3-A06-S12
	Field Sample ID	SXA06071	SXA06081	SXA06091	SXA06101	SXA06111	SXA06121
	Sample Date	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93
Test	Parameter						
EXPLOSIVES	2,4,6-Trinitrotoluene	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
TAL METAL	Aluminum	12700 !	4720	8020	10400	9780	7060
	Arsenic	7.00 J	4.85 J	5.30 J	5.95 J	2.70 J	3.91 J
	Barium	35.5 !	11.0	17.1	31.2 !	27.7 !	15.5
	Beryllium	0.483 J!@	0.067 J	0.276 J	0.674 !@	0.479 J!@	0.312 J
	Calcium	997	221 J	443 J	1030	1360 !	300 J
	Chromium	21.0 J!	6.49 J	9.81 J	16.7 J!	15.5 J!	7.34 J
	Cobalt	98.1 !	2.52	4.27	7.55 !	4.61	3.43
	Copper	24.0 !	23.8 !	15.6 !	13.6 !	11.7 !	5.77
	Iron	19000 !	8170	10300	13000 !	8130	9980
	Lead	17.0	32.0	36.0	61.0	24.0	160 !
	Magnesium	3400 !	567 J	1300	2110	2330 !	653
	Manganese	207 !	23.2	167 !	192 !	62.1	67.7
	Mercury	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
	Nickel	17.3 !	4.88	8.24	11.6 !	11.1 !	5.83
	Potassium	1990 !	401 K	505 K	718 !	739 !	513 K
	Selenium	< 0.200 J	0.367 J	0.245 J	0.534 J	0.305 J	< 0.200 J
	Sodium	187 KJ	187 KJ	200 KJ	266 K	177 KJ	151 KJ
	Vanadium	29.8	15.6	21.8	35.5 !	18.4	20.9
	Zinc	51.0 !	23.8	30.6	33.8	27.5	22.1
TCL Pest	Dieldrin	0.003 JU	0.003 JC	0.003 JU	0.002 JU	0.005 JU	0.003 JU
	Endosulfan,A	0.000 JC	0.001 JC	0.000 JC	< 0.002	< 0.002	0.001 JC
	Endosulfan,B	0.001 JC	< 0.002	0.001 JC	< 0.002	< 0.002	0.002 JC
	Heptachlor Epoxide	< 0.002	0.001 JU	0.001 JC	< 0.002	< 0.002	< 0.002
	Lindane	0.001 JC	0.002 JU	0.001 JU	0.001 JC	< 0.002	0.001 JC
	P,P-DDD	0.021 C	0.007 U	0.007 U	0.006 U	0.046 C	0.011 U
	P,P-DDE	0.200 C!	0.015 C	0.052 C	0.082 C	0.210 C!	0.040 C

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 5-11
Chemical Summary Report For Surficial Soils
Site: A06
Units: UGG

	Site ID	E3-A06-S07	E3-A06-S08	E3-A06-S09	E3-A06-S10	E3-A06-S11	E3-A06-S12
	Field Sample ID	SXA06071	SXA06081	SXA06091	SXA06101	SXA06111	SXA06121
	Sample Date	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93	09/14/93
Test	Parameter .						
TCL Pest	P,P-DDT	0.093 JC	0.008 KC	0.021 JC	0.035 JC	0.200 JC	0.021 JC
	alpha-BHC	< 0.002	< 0.002	< 0.002	< 0.002	0.001 JC	0.001 JC
TOC	Total Organic Carbon						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 5-12
Chemical Summary Report For Sediments
Site: A06
Units: UGG

Test	Parameter	E3-A06-D01	E3-A06-D02				
	Field Sample ID	DXA06011	DXA06021				
	Sample Date	09/14/93	09/14/93				
TAL METAL	Aluminum	6130 !	3810				
	Arsenic	5.66 !	2.65 !				
	Barium	18.8	22.2				
	Beryllium	0.400 J!	0.393 J!				
	Calcium	2410 !	1120 !				
	Chromium	7.83	7.79				
	Cobalt	3.45	2.10				
	Copper	7.01 !	2.94				
	Iron	4690	3360				
	Lead	9.78 !	3.76				
	Magnesium	1280	1030				
	Manganese	42.0	32.5				
	Nickel	8.03 !	4.92				
	Potassium	573 K	437 K				
	Sodium	246 KJ	189 KJ				
	Vanadium	9.14	7.08				
	Zinc	63.7 !	41.0 !				
TCL Pest	Dieldrin	0.005 C!#	0.002 JC#				
	Heptachlor Epoxide	0.001 JC	< 0.002				
	P,P-DDD	0.124 C#	0.009 C#				
	P,P-DDE	0.031 C#	0.013 C#				
	P,P-DDT	0.005 C#	0.003 C#				
	alpha-Chlordane	0.001 JC#	0.001 JU#				
TOC	Total Organic Carbon	60600	25500				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

5.2.2 Site P22 — Old Gravel Pit

Site P22, a former gravel pit, was originally identified by the EPA in 1982. The area was discovered through a review of aerial photography and was noted as a possible dump or disposal site. Figure 5-3 presents a site map.

5.2.2.1 Site Location

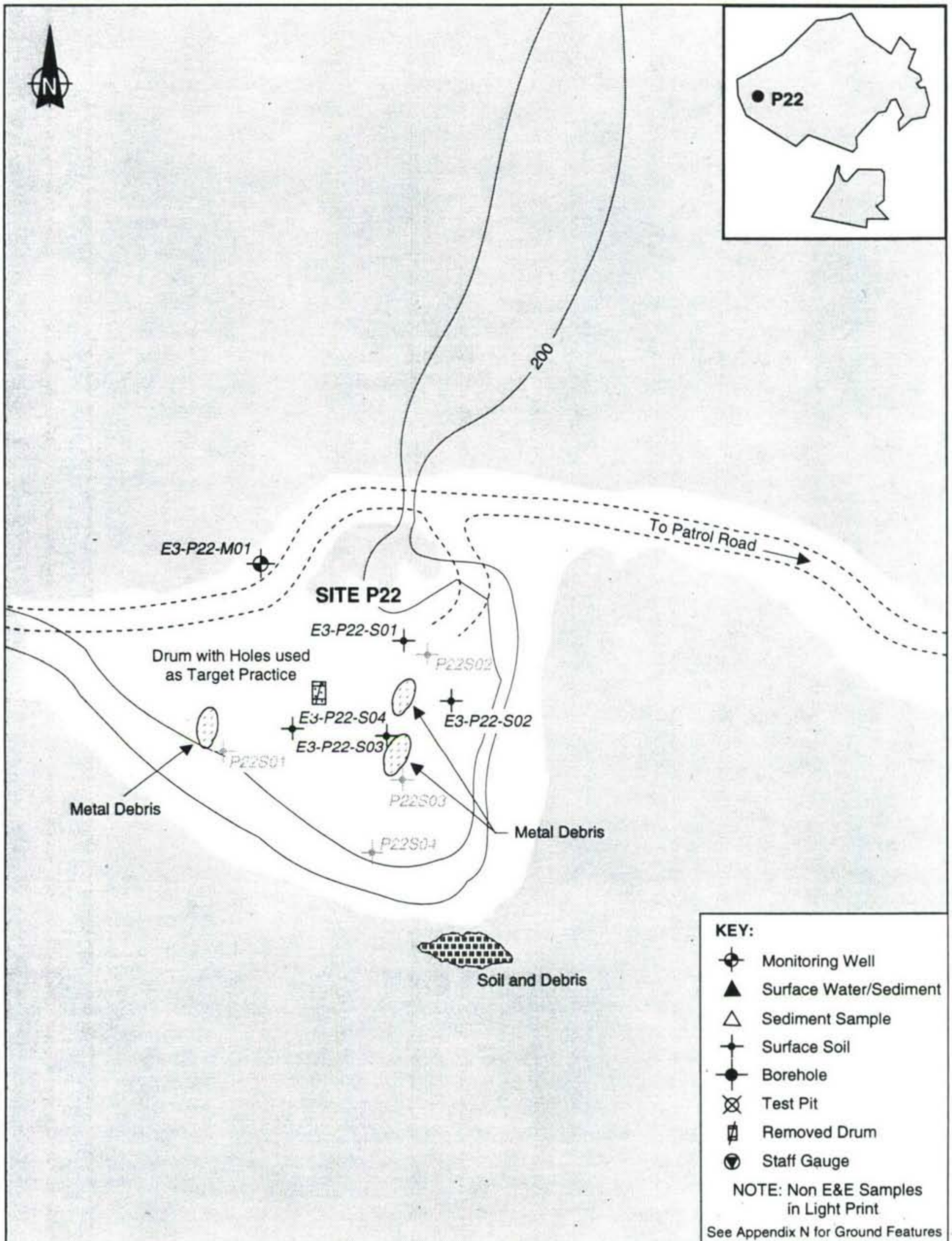
This area is situated on the western part of the Annex. It is accessed through a gate via an unpaved road leading west from Patrol Road. There are motorcycle tracks throughout the area and the dirt road appears to have been used as a motorcycle recreation area. About 1,650 feet west on this road, there is a large, sandy depression surrounded by forest. In the center of the pit, and also distributed around the pit, there is metal debris including vacuum cleaners, tires, metal jerry cans, and cables. A drum that appears to have been used for target practice lies in the sandy depression.

5.2.2.2 Physical Characteristics

Site P22 is located on an outwash plain of sand and gravel. Surface elevations in the pit itself are approximately 185 feet AMSL, but rise to 200 feet AMSL around the pit to the west, south, and east. Average groundwater elevation, as estimated from measurements collected at monitoring well E3-P22-M01, is 181 feet AMSL.

E & E installed a single monitoring well (E3-P22-M01) at Site P22 in 1993. Outwash material consisting of variable layers of sand, silt, and gravel mixtures extended to 18 feet BGS at this location. The total depth of the boring at well E3-P22-M01 was 18 feet. Soil samples were collected from the 4 to 6 foot interval and the 14 to 16 foot interval and submitted for grain size and Atterberg limits analyses. Both soil samples were subsequently identified as non-plastic, poorly graded sands with a slightly greater amount of fine-grained material identified in the 4 to 6 foot interval. Additional grain size and Atterberg limits analyses was performed on surface soil sample E3-P22-S02. This soil was identified as non-plastic, well-graded sand with silt. Appendix D contains a complete summary of geotechnical results. Bedrock was not encountered during monitoring well installation and depth to bedrock is unknown. The underlying bedrock material is presumed to be Gospel Hill Gneiss (Hansen 1956).

A slug test performed at E3-P22-M01 by E & E in 1993 yielded a calculated transmissivity of 80.99 feet^2 per day. The average aquifer thickness was presumed to be equal to the length of the water column in the well at the time of the slug test. Comparably low transmissivities have been calculated for wells installed in similar outwash material throughout the Annex. Transmissivity may, however, be underestimated due to a



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 5-3 MAP OF SITE P22 OLD GRAVEL PIT

conservative approximation of aquifer thickness. The transmissivity was calculated as follows:

$$T = Kb$$
$$T = (6.520)\ (12.42)$$
$$T = 80.99 \text{ feet}^2 \text{ per day}$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer thickness (feet)

Appendix G contains complete slug test data and interpretation.

Surface water runoff at Site P22 remains in the site, pooling in the pit basin as standing water and eventually percolating through the soil to the groundwater below. Topography, drainage, and watershed-wide water levels indicate groundwater flows north from Site P22 towards a wetland adjacent to the Assabet River. It may possibly be discharging first to the small stream below Site A6, before reaching the river.

5.2.2.3 Ecological Characterization

Situated on the northwestern part of the Sudbury Annex, this site consists of an open, disturbed, sandy, man-made depression approximately 4,000 square feet in size. Small patches of grasses and forbs are scattered throughout the depression, and numerous motorcycle tracks were observed. A dense forest consisting primarily of white pine and oak trees ranging from 40 to 60 feet in height surrounds the entire site (LFS 1983).

Based on the topography of the area, surface water runoff is expected to flow to the north through an extensive wetland area associated with the Assabet River. Located approximately 1,600 feet north of the site, this wetland is seasonally saturated and vegetated with deciduous trees (USDOI 1977).

In general, the following habitats are associated with this area: open, disturbed clearing, upland forest, forested wetland, and open water. The open, disturbed area is of little value to wildlife. The abundance of motorcycle tracks suggests frequent disturbance and noise, which is expected to limit vegetation to rapidly growing annuals and to discourage wildlife. Although the surrounding forest may also be affected by the human activities on site, the pines and oaks in this area are expected to sustain a diverse community. Small mammals, songbirds, upland gamebirds, and deer feed on pine seeds, oak acorns, pine needles, buds, and twigs (Martin *et al.* 1951). In addition, the dense canopy and understory provide shelter to deer and rabbits, particularly during the winter. Forested wetlands similar to the one located north of the site provide valuable cover, food, nesting and roosting areas to many upland, semi-aquatic, and aquatic wildlife. The Assabet River, the final receptor of surface water and groundwater from the site, constitutes a habitat of great value to wildlife.

Wide and slow-flowing rivers create long-edge habitats, which provide drinking water, food, breeding areas, and shelter for permanent residents and for animals that regularly visit from other habitats. For example, amphibians, reptiles, and waterfowl predominantly occur on the shallow riverbanks, while piscivorous birds feed on fish throughout the river. In addition, rivers provide safe migration corridors to many species.

There are no documented rare, threatened, or endangered species or unique habitats associated with this site (NHESP 1992).

5.2.2.4 Site History

Site P22 has been in continuous use as a gravel pit since the 1940s. Household and general refuse dumping has occurred here. The area was not among those identified by Natick Laboratory employees as one of the possible chemical disposal areas. Maps from the 1940s through the 1980s identify an access road to the site that leads from Patrol Road, past the gravel pit, and out toward Sudbury Road. It is probable that this road existed before 1942. No buildings, structures, or organized activity were noted for this site in any facility map or file. The area shows current signs of use for off-road motorcycle riding, target practice, and the dumping of household-type refuse.

5.2.2.5 Results of Previous Investigations

Investigations at Site P22 through mid-1992 are described in Section 7.31 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). In 1984, Dames and Moore performed an Enhanced Area Reconnaissance of Site P22, identifying several small dumping areas within the cleared depression, or pit. In 1992, OHM conducted an Enhanced Area Reconnaissance that included surface soil sampling at Site P22. A series of mounds was noted west of the area and a drum as well as some scrap metal were discovered on the eastern part of Site P22.

OHM collected four surface soil samples from various parts of the pit. Only one explosive, nitroglycerine (2.86 μg/g) was found in P22S03. As compared to background soil levels, metals were elevated in surface soil sample P22S02. Maximum concentrations were aluminum (28,000 μg/g), arsenic (27 μg/g), barium (51 μg/g), beryllium (0.85 μg/g), chromium (30.3 μg/g), cobalt (8.98 μg/g), copper (27.8 μg/g), iron (23,000 μg/g), magnesium (3,800 μg/g), nickel (20.6 μg/g), potassium (1,590 μg/g), vanadium (34.9 μg/g), and zinc (50.6 μg/g). Lead (180 μg/g) exceeded background soil levels in all four samples.

PAHs found in sample P22S01B were anthracene (0.37 μg/g), benzo(*a*)pyrene (6.0 μg/g), benzo(*b*)fluoranthene (4.0 μg/g), benzo(*g,h,i*)perylene (3.0 μg/g), chrysene (4.0 μg/g), phenanthrene (1.4 μg/g), fluoranthene (2.3 μg/g), pyrene (3.0 μg/g), and indeno (1,2,3–c,d)pyrene (3.0 μg/g).

5.2.2.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and explosives. A surface soil sample and a subsurface soil sample were analyzed for TOC and for grain size. The Phase II sampling effort activities for Site P22 are summarized in Table 5-13.

Table 5-13

PHASE II SAMPLING EFFORT FOR SITE P22 — OLD GRAVEL PIT

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	2	08/31/93 12/02/93	Samples were collected to characterize groundwater quality and the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	1	08/03/93	A geotechnical sample was collected from the well's screened interval to characterize the nature of subsurface soils at the gravel pit.
	1	08/03/93	Sample was collected from screened interval and sent for TOC analysis to provide further data on the characteristics of surface soils on site.
Surface Soils	4	09/14/93 09/15/93 09/16/93	Samples were collected from areas adjacent to debris or in surface drainage channels to investigate surface contamination at the gravel pit.
	1	09/14/93	Sample was collected from location E3-P22-S02 and sent for TOC analysis to further characterize nature of site surface soils.
	1	09/14/93	A geotechnical sample was collected at location E3-P22-S01 to determine grain size and further characterize the nature of soils and their impact on contaminant migration.

Source: Ecology and Environment, Inc. 1994.

Geophysical Investigations

A magnetometer survey was conducted at the nodes of a grid laid out across the gravel pit to identify any subsurface anomalies that would indicate buried debris. No anomalies were measured during the survey except those that were attributed to metallic debris seen on the surface.

Groundwater Sampling

To characterize groundwater quality at the old gravel pit, E & E installed, developed, and sampled one shallow overburden monitoring well along the northern downgradient edge of the pit. The well was screened across the water table at an interval 8 to 18 feet BGS. A total of two rounds of groundwater samples were collected from the well, one each during the August and December 1993 sampling events. Both filtered and unfiltered samples were collected at each round for TAL metals. These samples provided data for assessment of groundwater quality and potential contaminant migration through the groundwater pathway.

Subsurface Sampling

During well installation geotechnical samples were collected from the screened interval and sent for grain size and Atterberg limits analyses. Another sample was collected and sent for TOC analysis. These samples provided data for assessment of the nature of subsurface soils in the area and their impact on contaminant migration potential through the groundwater pathway.

Surface Soil Sampling

Four surface soil samples were collected from locations in the old gravel pit to investigate surface soil contamination due to past activities at the site. The samples were collected from areas adjacent to surface debris or from locations that are in surface runoff channels. The samples provide data on the nature of the surface soils on site and the potential for contaminant migration through the surface pathway. One additional sample E3-P22-S02 was collected and sent for TOC analysis to provide further data on the characteristics of the surface soils on site and their impact on potential contaminant migration through the surface pathway.

5.2.2.7 Nature and Extent of Contamination

The initial concern at this site was that debris in the gravel pit may have resulted in contamination of surrounding media. Analysis of previous and recent sampling indicates some limited areas of PAH contamination in soils at the site, but no impacts on groundwater. The magnetometer survey at the site did not identify any subsurface debris. Table 5-14 provides a summary of detections above preliminary screening levels at the site. A summary of analytical results for Site P22 is provided in Tables 5-15, 5-16, and 5-17 at the end of this section.

Analysis of unfiltered samples taken from the newly installed well (E3-P22-M01) at this site indicated that aluminum (913 μg/L) and iron (1,030 μg/L) were the only metals above the Massachusetts Secondary MCLs of 50 μg/L for aluminum and 300 μg/L for iron. The levels of these metals dropped significantly in the filtered sample indicating the results in the unfiltered sample are probably due to the presence of suspended solids in the groundwater. Both aluminum and iron levels dropped below the reporting limit. No volatile or semivolatile organic compounds, pesticides or explosives were found in groundwater sampling at this site.

Analysis of four soil samples collected by E & E at this site indicated several metals above concentration background levels, but none above soil screening levels. The likely source of these elevated metals is runoff from the metal debris at the site. The highest concentrations of several PAHs, including benzo(*a*)anthracene (1.10 μg/g), benzo(*a*)pyrene (1.20 μg/g), benzo(*a*)fluoranthene (1.10 μg/g), and chrysene (1.30 μg/g) were found in two of

Table 5-14

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P22

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1]	--	50	MA SMCL[3]	913	E3-P22-M01	1/1
	Aluminum(F)[2]	--			<25.0	E3-P22-M01	0/1
	Iron(U)	---	300	MA SMCL	1,030	E3-P22-M01	2/2
	Iron(F)	--			<25.0	E3-P22-M01	0/2
SOIL (μg/g)	Benzo(*a*)anthracene	--	0.7	MCP GW-1/S-1[4]	1.10	E3-P22-S03	2/5
	Benzo(*a*)pyrene	--	0.7	MCP GW-1/S-1	1.20	E3-P22-S02	2/5
	Benzo(*b*)fluoranthene	--	0.7	MCP GW-1/S-1	1.10	E3-P22-S02	1/5
	Chrysene	--	0.7	MCP GW-1/S-1	1.30	E3-P22-S03	2/5

[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

four samples at levels above the soil screening value for these compounds of 0.7 μg/g (MCP GW-1/S-1 and MCP GW-3/S-3). These two samples (E3-P22-S02 and E3-P22-S03) were taken near several of the pockets of metal debris or in the runoff path from the debris. Several other PAHs were also detected in soil samples but below screening levels. PAHs were previously detected at elevated levels by OHM in one sample (P22S01) taken near one of the pockets of debris. Trace concentrations of several pesticides were also detected in E & E samples, but none of the levels were above maximum detections in background soil samples. No explosives were detected in E & E soil samples at the site.

5.2.2.8 Conclusions and Recommendations

E & E sampling at the site confirmed the presence of some areas of PAH soil contamination around metal debris at the site. The presence of these compounds confirms previous OHM sampling results. The detection of nitroglycerine by OHM in one sample (P22S03) does not seem to indicate any level of explosive contamination at the site, given that no explosives were detected in any of the other soil samples taken by OHM or E & E (a total of seven other soil samples). No other compounds were detected in soil sampling at levels above soil screening values. Groundwater sampling did not identify any impact of the site on groundwater.

Given the limited surficial PAH contamination near areas of metal debris and the accessibility of this site, further action is recommended at this site. The army has removed the metal debris from Site P22 which removed the likely source of PAHs from the site. However, PAHs were detected in soil above screening levels by both OHM and E & E. This site is accessible by a bath leading from an off-site residential area. Removal of the PAH contaminated soils should also be considered.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 5-15
Chemical Summary Report For Groundwater
Site: P22
Units: UGL

	Site ID	E3-P22-M01	E3-P22-M01	E3-P22-M01	E3-P22-M01	E3-P22-M01	E3-P22-M01
	Field Sample ID	MDP22011	MFP22011	MFP22012	MHP22011	MXP22011	MXP22012
	Sample Date	08/31/93	08/31/93	12/02/93	08/31/93	08/31/93	12/02/93
Test	Parameter .						
TAL METAL	Aluminum	913 @	27.4 B	< 25.0	60.6 B@	906 @	824 @
	Arsenic	1.62 J	< 2.00	< 2.00	< 2.00	1.95 J	2.44
	Barium	22.3	6.80 J	< 10.0	6.32 J	24.5	13.0
	Calcium	2850	1850	2740	1900	2740	3140
	Copper	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	3.38 J
	Iron	506 @	< 25.0	< 25.0	29.0 B	509 @	1030 @
	Lead	< 5.00	< 5.00	3.05 J	< 5.00	< 5.00	1.02 BJ
	Magnesium	735	449 J	535	427 J	749	765
	Manganese	32.3	20.8	5.40 B	21.1	31.8	22.7
	Nickel	9.58 J	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
	Potassium	862 J	827 J	< 1000	920 J	1320	965 BJ
	Sodium	3630	3490	1530 BJ	3300	3440	2970 B

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 5-16
Chemical Summary Report For Subsurface Soils
Site: P22
Units: UGG

	Site ID	E3-P22-M01					
	Field Sample ID	BX2201X1					
	Sample Date	08/03/93					
Test	Parameter Depth	9.0 ft.					
TOC	Total Organic Carbon	3210					

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 5-17
Chemical Summary Report For Surficial Soils
Site: P22
Units: UGG

	Site ID	E3-P22-S01	E3-P22-S01	E3-P22-S02	E3-P22-S03	E3-P22-S04	
	Field Sample ID	SDP22011	SXP22011	SXP22021	SXP22031	SXP22041	
	Sample Date	09/14/93	09/14/93	09/14/93	09/16/93	09/15/93	
Test	Parameter .						
TAL METAL	Aluminum	6850	7790	6030	7560	8590	
	Antimony	0.757 KL!	0.546 BL!	1.36 L!	2.61 !	1.66 L!	
	Arsenic	9.36	10.6 !	8.61	6.94	15.0 !	
	Barium	22.9	22.5	25.5 !	24.5	37.6 !	
	Beryllium	0.299 JL	0.296 J	0.232 JL	0.287 JL	0.373 JL	
	Calcium	432 J	1020	560	424 J	772	
	Chromium	14.6 !	15.9 !	13.2	15.9 !	19.3 !	
	Cobalt	8.30 !	7.52 !	7.07 !	9.58 !	9.98 !	
	Copper	13.5 L!	16.7 !	22.9 L!	22.5 L!	21.9 L!	
	Iron	15000 !	13000 !	11000	17000 !	13000 !	
	Lead	90.0	81.0	200 !	170 !	200 !	
	Magnesium	259400 !	299400 !	274400 !	2720 !	328400 !	
	Manganese	176 !	175 !	183 !	205 !	228 !	
	Nickel	15.5 !	14.3 !	13.7 !	18.2 !	17.7 !	
	Potassium	1270 !	1210 !	1260 !	1250 !	1790 !	
	Sodium	48.1 BJ	170 KJ	50.1 BJ	< 20000	< 20000	
	Thallium	< 0.500	< 0.500	< 0.500	0.105 J	< 0.500	
	Vanadium	16.8	20.7	14.5	16.4	19.5	
	Zinc	35.5 J	45.3 !	29.5 J	41.5 J	57.2 J!	
TCL BNA	13DMPY			0.140			
	28DMBT				0.120		
	Acenaphthene	< 0.330	< 0.330	0.094 J	< 0.330	< 0.330	
	Anthracene	< 0.330	< 0.330	0.064 J	0.069 J	0.025 J	
	BJFANT	0.220	0.200	0.790			
	Benzo(a)anthracene	0.160 J	0.140 J	1.00 @	1.10 @	0.290 J	
	Benzo(a)pyrene	0.210 J	0.200 J	1.20 @	0.990 @	0.420	
	Benzo(b)fluoranthene	0.240 J	0.210 J	1.10 @	0.480	0.440	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 5-17
Chemical Summary Report For Surficial Soils
Site: P22
Units: UGG

	Site ID	E3-P22-S01	E3-P22-S01	E3-P22-S02	E3-P22-S03	E3-P22-S04
	Field Sample ID	SDP22011	SXP22011	SXP22021	SXP22031	SXP22041
	Sample Date	09/14/93	09/14/93	09/14/93	09/16/93	09/15/93
Test	Parameter .					
TCL BNA	Benzo(ghi)perylene	0.110 J	0.140 J	0.630	0.510	0.210 J
	Benzo(k)fluoranthene	0.068 J	< 0.330	0.270 J	0.092 J	0.130 J
	Chrysene	0.220 J	0.180 J	1.30 @	1.30 @	0.440
	Dibenzo(a,h)anthracene	< 0.330	< 0.330	0.220 J	0.140 J	0.062 J
	Fluoranthene	0.110 J	0.110 J	0.530	0.230 J	0.250 J
	Indeno(1,2,3-cd)pyrene	0.120 J	0.120 J	0.510	0.200 J	0.180 J
	Phenanthrene	0.050 J	0.050 J	0.280 J	0.520	0.120 J
	Pyrene	0.130 J	0.130 J	0.760	1.60	0.340
TCL Pest	Dieldrin	0.001 JC	0.001 JC	0.002 U	0.001 JU	0.003 U
	Endosulfan,A	0.000 JC	< 0.002	< 0.002	< 0.002	< 0.002
	Endosulfan,B	0.002 JU	0.001 JC	0.001 JU	< 0.002	0.002 U
	Endrin	0.002 BU	< 0.002	0.001 BJC	0.001 BJU	0.005 KC
	Heptachlor Epoxide	0.001 JC	< 0.002	0.000 JU	< 0.002	0.002 JC!
	P,P-DDE	0.004 C	0.004 C	0.001 JC	0.001 JC	0.003 C
	P,P-DDT	0.010 CK	0.010 CK	< 0.002	0.002 JU	0.006 KC
	alpha-BHC	0.000 JC	< 0.002	< 0.002	< 0.002	< 0.002
	alpha-Chlordane	0.000 JU	< 0.002	< 0.002	< 0.002	0.002 C
	gamma-Chlordane	< 0.002	< 0.002	< 0.002	< 0.002	0.003 C
TOC	Total Organic Carbon			6680		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

6. WATERSHED 5 — BOONS POND (LAKE BOON)

6.1 WATERSHED DESCRIPTION AND ASSESSMENT

Proposed investigative activities for the sites identified at the Annex were determined through a review of previous activities and findings and are governed by the established SOW. The objectives of the activities are to determine whether contamination is present in groundwater, surface water, sediment, or surface/subsurface soils at the assigned Phase II sites, and, in the cases where contamination is thought or known to exist, to confirm and better characterize its nature and extent.

To evaluate each site, and to develop a better understanding of the site's impact on the Annex environment, the Annex was divided into seven distinct watersheds. In this report, general findings of the field effort are first summarized for each watershed as a whole. Detailed information about activities undertaken and sampling results are then provided for each site. Conclusions and recommendations are reviewed and discussed in conjunction with the findings of the Phase I investigation conducted by OHM. Data results are provided with each site investigation section. The methodology used in the screening of analytical results generated through this Phase II SI, and the screening values used to identify areas of possible concern, are fully explained in Section 7, Volume I of this report. The appendices provide field reports, special studies, and QA/QC results to support the information presented in the text.

The sites in Watershed 5 — Boons Pond are shown in Figure 6-1. For ease of reference, Table 6-1 identifies each site in the watershed by number, name, and status with respect to ongoing investigation activities.

Table 6-1

WATERSHED 5 SITES

Site Number	Site Name	Current Status
A5	Solvent Waste Dump	Site Investigation
P31/P58	Old Dump; Sudbury Road Dump	Site Investigation
P40	Building T452 Area	Site Investigation

Source: Ecology and Environment, Inc. 1994.

6.1.1 Watershed Location and Description

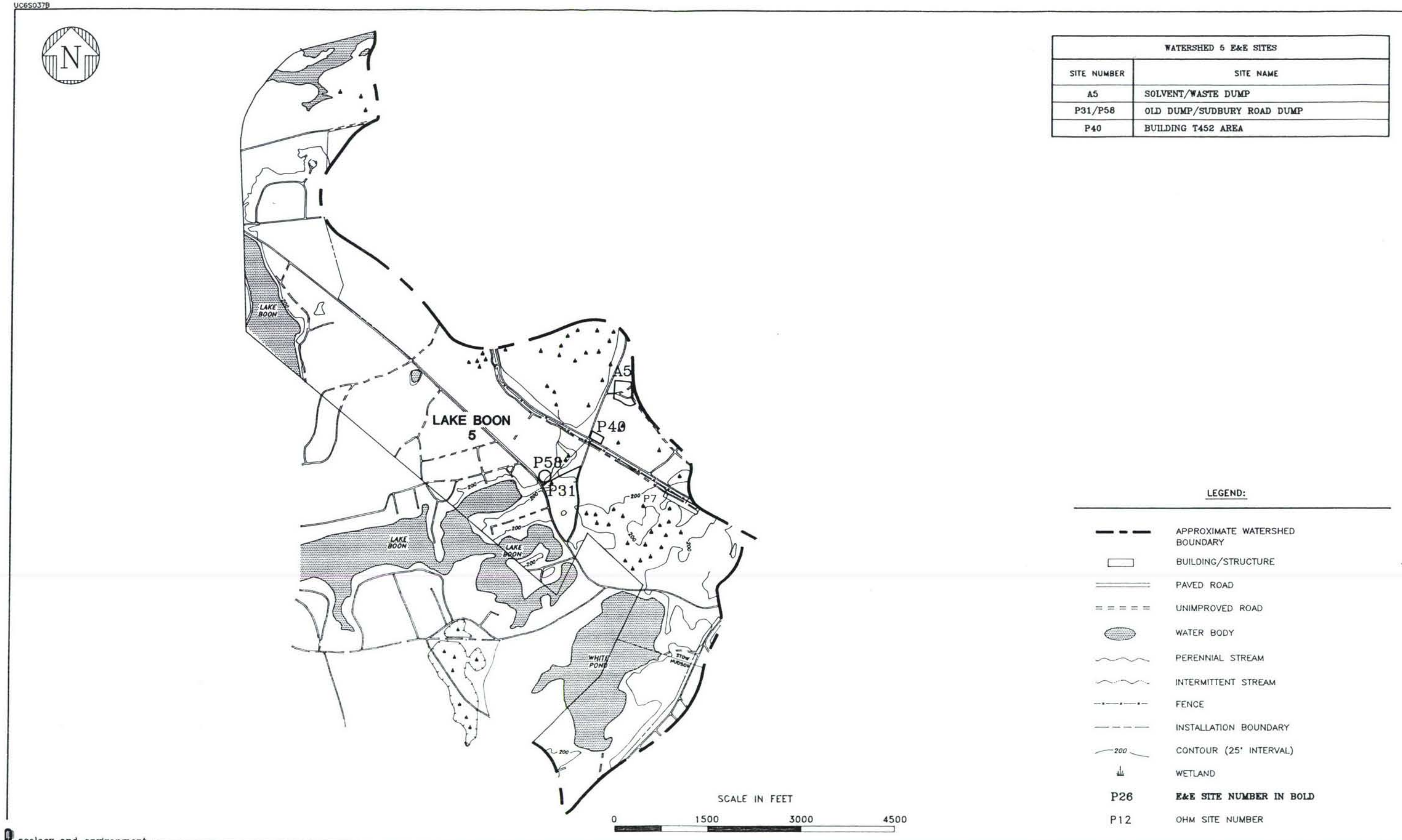
Watershed 5 is to the south and west of the main portion of the Annex and drains to Boons Pond and White Pond. It contains the only water supply wells and the only municipal

water supply that could be threatened by known sites or sites formerly identified at the Annex. In this watershed, Sites A5, P31, P40, and P58 have been investigated by E & E. Except for the southern end of the hill in the center of the bunker area and the west side of the hill east of the MFFA, the area has very slight relief (no more than 20 feet). There are extensive wetlands and hydraulic gradients are low. Water table contours indicate generally a southwesterly flow from Site A5 to Site P40, to Site P31 and Site P58. Groundwater northeast of Boons Pond discharges into Boons Pond, and groundwater northeast of White Pond, including that from Site P7, discharges to White Pond. As mentioned in the discussion of Watershed 2, a buried valley of the preglacial Assabet River runs under the east end of Boons Pond and under the south end of White Pond. Bedrock in these areas is below 100 feet AMSL, resulting in depths of glacial outwash of up to 100 feet or more. Both proglacial and ice-contact deposits (eskers and kames) are present. The proglacial deposits are coarse and well-drained at the surface, but the deeper wells (over 50 feet) at Site A5 and Site P40 ran into silt and silty sand at depths below 14 to 15 feet, while the deeper well at Site P58 ran into very fine-grained, flowing sand at 34 feet BGS. Bedrock was encountered in an OHM borehole at 61 feet BGS at Site P40, but no sample was collected. A pilot hole for a deep well not subsequently installed at Site A5 (OHM-A5-6) encountered fine to course sand with gravel to 16 feet, silt and fine sand to 90 feet, what appears to be till to 102.5 feet, and bedrock to 117.5 feet. Bedrock was fine-grained schist classified as Marlboro Formation (OHM 1992).

The relationship between White Pond and Boons Pond appears to have changed between 1955 and 1994. The water level at Boons Pond is kept at a nearly constant elevation of 185 to 186 feet AMSL by an artificial dam at the outlet located on the western end of the Pond. White Pond's water level was approximately 189 feet AMSL in 1955, but has declined and now appears to be at an elevation equal to Boons Pond. The decline is suspected to be caused by the Town of Maynard's withdrawals from White Pond, which exceeded 100 million gallons in 1993. This amount is probably greater than the entire recharge of the area draining into White Pond and of the pond itself.

The Town of Maynard's withdrawals from White Pond have created a hydraulic gradient sloping towards the pond from all directions. The pond behaves like a very large-diameter well and is probably expanding the area of its groundwater capture. If this continues, White Pond may begin to capture flow from Boons Pond. This would reduce flow out of the northwest end of Boons Pond where it discharges to the Assabet River. If White Pond continues to be pumped at a rate greater than it can be recharged, groundwater flow to Boons Pond from Site A5 and Site P40 may be diverted to meet White Pond water demand. Due to the proximity of the pond, flow from Site P31 and Site P58 will probably continue to go to Boons Pond unless a sharp drawdown on White Pond occurs. This latter case seems unlikely since any drawdown of White Pond would tend to cause large flows of water out of Boons Pond in response to the hydraulic gradient towards White Pond.

Generalized groundwater flow and site-specific flow directions were determined from field observations of topography, drainage, and water-level measurements collected during two field events in 1993 (September 13 and December 3). Watershed 5 groundwater



WATERSHED 5 E&E SITES	
SITE NUMBER	SITE NAME
A5	SOLVENT/WASTE DUMP
P31/P58	OLD DUMP/SUDBURY ROAD DUMP
P40	BUILDING T452 AREA

Figure 6-1 WATERSHED 5 – LAKE BOON

Table 6-2

WATERSHED 5 — BOONS POND WATER LEVEL MEASUREMENTS*

Site	Well	Water Levels**	
		09/13/93	12/03/93
A5	E3-A5-M01	193.77	191.75
	OHM-A5-24	195.80	196.10
	OHM-A5-44	196.07	196.58
	DM6	195.93	196.33
P7	OHM-P7-28	191.28	191.24
	OHM-P7-30	191.08	191.63
	OHM-P7-31	191.41	190.89
P31	E3-P31-M01	185.11	Not taken
P40	OHM-P40-29	193.53	193.70
	OHM-P40-38	194.42	194.37
	OHM-P40-39	194.63	194.52
	EHA1	194.51	194.55
P58	E3-P58-M01	184.81	Not taken
	E3-P58-M02	184.74	Not taken
	OHM-BW-4	190.37	Not taken

*Including data collected from OHM, Dames and Moore, and EHA wells.
**All measurements are recorded in feet above mean sea level (AMSL).

Source: Ecology and Environment, Inc. 1994 (from Appendix P data).

elevation measurements are recorded in Table 6-2. Average groundwater elevations presented in the Physical Characteristics section of each site incorporate all groundwater-level measurements collected during both field events.

6.1.2 Preliminary Watershed-Wide Assessment

The watershed approach divides the Annex into areas draining to particular streams of surface water bodies, both by surface runoff (which is minimal at the Annex) and by groundwater flow. Within each watershed, the individual sites are potential sources of contaminants and the surface water and sediments are potential receptors or sinks. Movement of water through the Annex and the discharge of groundwater to surface water transports contaminants from the soil to groundwater and then to surface water and sediments. Sediment

layers are often organic-rich with high TOC that can adsorb contaminants in groundwater before they reach surface water. Any persistent toxics present in the groundwater discharge can accumulate in sediments and in biota living in the streams and ponds. The result is that the cumulative impact of all sites within this watershed tends to be concentrated in the sediments within the surface water draining the watershed and in surface water itself.

By analyzing results of sediment and surface water sampling at the Annex along a given drainage, findings about where discharges from specific sites enter the surface water pathways can be gathered. Samples taken at the point where drainages leave the Annex or join a larger stream allow an assessment to be made of the cumulative impact of a particular watershed. Sampling results were compared to background pond and stream levels and also to preliminary screening values. Surface water screening values include water quality criteria regarding both human health and aquatic life, while sediment screening values are ecologically oriented. Surface water and sediment sampling results were also compared to site-specific groundwater and soil sampling results to attempt to identify potential sources of watershed contamination. Sampling results from previous investigations by Dames and Moore in 1984 and 1985, OHM in 1992 and 1993, and E & E in 1993 and 1994 have all been considered in the watershed assessments. The number of samples used for analysis of particular contaminants varies depending on the analyte spectrum for each sample used in this assessment. The surface water and sediment locations considered in this watershed assessment are listed below in Table 6-3.

Table 6-3

SURFACE WATER/SEDIMENT SAMPLE LOCATIONS IN WATERSHED 5*

Site Location ID	Location
	Site A5/P40 Wetlands
E3-A5-D01	Wetland south of Site A5, east of Site P40
	Site P31/P58 Wetlands
P31SD1/SW1	Wetlands, northeast of main debris area at Site P58
E3-P58-D01	Wetlands, at main debris area at Site P58
P31SD2/SW2	Wetlands, on northeast side of culvert under Sudbury Road
	Drainage from Site P31/P58 to Boons Pond
E3-P58-D02 P31SD3/SW3	Small stream to Boons Pond, on southwest side of culvert under Sudbury Road
P31SD4/SW4	Small stream to Boons Pond, downstream of P31SD3/SW3
P31SD5/SW5	Small stream to Boons Pond, downstream of P31SD4/SW4

*From upstream to downstream and includes samples taken by OHM in 1992 and E & E in 1993.

Source: Ecology and Environment, Inc. 1994.

Watershed 5 includes surface water and groundwater drainage to Boons Pond and White Pond. The sites studied by E & E within the Watershed are Site A5, Site P31, Site P40, and Site P58. Only one drainage pathway occurs near these sites, and this originates in a large wetland west of both Site A5 and Site P40, and north of Patrol Road. The drainage

passes under Patrol Road in a culvert approximately 500 feet west of Building T452 at Site P40 and runs almost due south into a small wetland (approximately 1.5 acres) just north of Sudbury Road. Site P58 is on the west side of this wetland, and the dump area extends approximately 200 feet along the bank of the wetland from a point about 50 feet north of the road. Site P31 extends for 600 feet north from the road along the east side of the wetland and up a shallow gully draining down into the wetland from White Pond Road.

The only surface water and sediment samples collected near Site A5 and Site P40 were taken from an isolated wetland in a closed depression south southeast of Site A5 and east of Site P40, at a point approximately 450 feet east of Building T452. The surface water showed elevated aluminum (1,000 μg/L), and lead (80.7 μg/L), with the latter being eight times background and twenty-five times the screening level (MA CWA WQC for aquatic life). The sediment samples from the same spot showed one elevated pesticide α-chlordane (0.005 μg/g). This may be the result of past pesticide applications. The lead in the sediment is at 24.2 μg/g, even though the TOC is 427,000 μg/g or 42.7 percent. This calls into question either the sediment or the water analysis, since it is improbable that water at that concentration of lead would coexist with a sediment of such a high TOC containing so little lead. This site is upgradient of Site P31 via the groundwater and the results for surface water should be confirmed.

The remaining sediment and surface water samples in this watershed are all within 500 feet of one another in a line running down the wetland between Site P58 and Site P31 (three samples) and then along the drainage leading from the wetland to Boons Pond, on the south side of Sudbury Road (four samples). Five of the seven samples were collected by OHM in 1992, and two were collected by E & E in 1993. Two OHM samples, P31SD1/SW1 and P31SD2/SW2, were taken adjacent to Site P31, and E & E's sample, at E3-P58-D01 was taken from within the dump area of Site P58 where trash has been dumped into the wetland. Table 6-3 lists the samples from north to south. None of the samples were taken upstream of the waste disposal area, but, as noted above, P31SD1/SW1 is located across the tiny wetland, approximately 60 feet from actual debris in the Site P58 dump.

In the surface water sample at E3-P58-D01 taken in the debris area at Site P58, most of the metals were elevated above background, with arsenic (38.5 μg/L), cadmium (2.79 μg/L), chromium (1,500 μg/L), copper (6,300 μg/L), iron (6,900,000 μg/L), lead (7,300 μg/L), mercury (5.52 μg/L), nickel (939 μg/L), and zinc (31,000 μg/L) all found in concentrations above screening levels. The sediment sample taken at E3-P58-D01 also had elevated concentrations of all of the metals found in the surface water sample above screening levels, as well as several other metals. Given the shallowness of the water at E3-P58-D01, the surface water sample is likely to have contained substantial amounts of sediment, and the metals concentrations probably reflect sediment in the surface water sample. Apart from metals, the only other contaminant found in surface water at E3-P58-D01 was TPHC at 179 μg/L. The sediment sample at E3-P58-D01, however, contained concentrations of several PAHs and pesticides above screening levels in addition to a relatively elevated concentration of TPHCs (1800 μg/g).

In the two other samples taken in the wetland area north of Sudbury Road (Sites P31SW1/SD1 and P31SW2/SD2) no contaminants were found in surface water samples above background and screening levels, while lead, DDD, and endrin were found in sediment samples above background and screening levels. Lead was elevated in samples P31SD1 (72 μg/g) and P31SD2 (40 μg/g) above both background screening levels. DDD (at 0.19 μg/g) and endrin (at 0.2 μg/g) were found only in sample P31SD2.

The surface water and sediment samples downstream of Sudbury Road and below Sites P31 and P58 proceed from E3-P58-D02 just adjacent to Sudbury Road, to samples P31-SW3/SD3, then to P31SW4/SD4, and lastly to P31SW5/SD5 toward Boons Pond. No surface water sample was collected at location E3-P58-D02 due to low water at the time of sampling. The sediment sample at this point contained some metals in concentrations above background but none above screening levels. Several PAHs were found at concentrations above site soil or sediment screening levels, probably due to the proximity of the sample point to Sudbury Road. Pesticides were also found in concentrations above screening levels, but at levels that probably reflect past pest management practices rather than any site-related source. TPHC was also found (at 129 μg/g), which is below the level found in the dump area at E3-P58-D01.

In the samples taken further downstream of Sudbury Road, arsenic, manganese, sodium, and zinc were found in surface water above background levels. Arsenic was found above background and screening levels in samples P31SW3 and P31SW4, but not at the farthest downstream sample at P31SW5. Zinc, while above background in samples P31SW3 and P31SW4, was below surface water screening levels. Manganese and sodium were above background in P31SW3 and P31SW4, and manganese alone was above background in Site P31SW5. No surface water screening value was found for manganese or sodium.

The sediment sample P31SD3 contained arsenic above background and screening levels. Arsenic was also above background in sediment samples P31SD4 and P31SD5 but was below sediment screening levels. Cobalt, lead, and manganese were found in sediment sample P31SD3 above background but below screening levels. Iron, manganese, and nickel were found above background but below screening levels.

From the sampling data, it appears that material in the Site P58 dump provides high levels of iron to the sediments in the wetland, and to sediments adjoining the dump. This has resulted in the sorption of a number of other metals, either from dump material or from the environment. The high TOCs in the wetland have also favored sorption of low levels of organics, notably PAHs and pesticides. Given the sampling data for the sediment samples on the south side of Sudbury Road, the sediments at the dump were not resulting in any marked off-site migration to Boons Pond as indicated by the declining levels of metals and other contaminants as one proceeds further downstream, probably because of the low rates of flow in the wetland.

Table 6-4 and 6-5 list the compounds found in surface waters and sediments in Watershed 5 above background and screening levels.

Table 6-4

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SURFACE WATERS IN WATERSHED 5 (μg/L)

Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Sample ID	Above Background and Screening Levels	
						Locations Found	Frequency
Arsenic	3.15	0.018	MA/CWA WQC[1]	38.5	E3-P58-D01	P58 debris, drainage from P31/58 to Lake Boon	3/7
Cadmium	<5.0	1.1	MA/CWA WQC[2]	2.79	E3-P58-D01	P58 debris	1/7
Chromium	<10.0	210	MA/CWA WQC[2]	1,500	E3-P58-D01	P58 debris	1/7
Copper	10.30	12	MA/CWA WQC[2]	6,300	E3-P58-D01	P58 debris	1/7
Iron	4,810	1,000	MA/CWA WQC[2]	6,900,000	E3-P58-D01	P58 debris	1/7
Lead	10.3	3.2	MA/CWA WQC[2]	7,300	E3-P58-D01	P58 debris, wetlands south of A5	2/7 (>Background) 3/7 (>Screening)
Mercury	--	0.012 0.14 2	MA/CWA WQC[1] MA/CWA WQC[2] SDWA MCL[3]	5.52	E3-P58-D01	P58 debris	1/7
Nickel	<10.0	610 160	MA/CWA WQC[1] MA/CWA WQC[2]	939	E3-P58-D01	P58 debris	1/7
Zinc	13.3	110	MA/CWA WQC[2]	31000	E3-P58-D01	P58 debris	1/7

[1]MA CWA WQC = Massachusetts / Clean Water Act Water Quality Criteria for protection of human health re: consumption of water and fish.
[2]MA CWA WQC = Massachusetts / Clean Water Act Water Quality Criteria for protection of aquatic life.
[3]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.

Source: Ecology and Environment, Inc. 1994

Table 6-5

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SEDIMENT IN WATERSHED 5 (μg/g)

Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Above Background and Screening Levels	
						Location Found	Frequency
Antimony	--	2	NOAA ERL[1]	6.04	E3-P58-D01	Site P58 debris	1/8
Arsenic	2.03	6	Ontario MOE LEL[2]	17	P31SD3	Site P58 debris, Sites P31/58 drainage at Sudbury roadside	2/8
Cadmium	1.79	0.6	Ontario MOE LEL	28.8	E3-P58-D01	Site P58 debris	1/8
Chromium	9.66	26	Ontario MOE LEL	131	E3-P58-D01	Site P58 debris	1/8
Cobalt	3.74	50	Ontario MOE LEL	59.7	E3-P58-D01	Site P58 debris	1/8
Copper	6.33	16	Ontario MOE LEL	600(L)[4]	E3-P58-D01	Site P58 debris	1/8
Iron	7,590	20,000	Ontario MOE LEL	280,000	E3-P58-D01	Site P58 debris	1/8
Lead	4.48	31	Ontario MOE LEL	950	E3-P58-D01	Site P58 debris and wetlands	3/8
Manganese	70.5	460	Ontario MOE LEL	963	E3-P58-D01	Site P58 debris	1/8
Mercury	--	0.15	NOAA ERL	0.765	E3-P58-D01	Site P58 debris	1/8
Nickel	5.92	16	Ontario MOE LEL	109	E3-P58-D01	Site P58 debris	1/8
Zinc	20.8	120	NOAA ERL	3,600	E3-P58-D01	Site P58 debris	1/8
2-methyl naphthalene	--	0.065	NOAA ERL	0.160(J)[5]	E3-P58-D02	Sites P31/58 drainage at Sudbury roadside	1/8
Anthracene	--	0.085	NOAA ERL	0.140(J)	E3-P58-D02	Sites P31/58 drainage at Sudbury roadside	1/8
Benzo(*a*) anthracene	--	0.23	NOAA ERL	0.660	E3-P58-D02	Sites P31/58 drainage at Sudbury roadside	1/8
Benzo(*a*) pyrene	--	0.4	NOAA ERL	2.00	E3-P58-D01	Site P58 debris, Sites P31/58 drainage at Sudbury roadside	2/8
Benzo(*b*) fluoranthene	--	0.7	MCP GW-1/S-1 soil value[3]	0.960	E3-P58-D02	Sites P31/58 drainage at Sudbury roadside	1/2
Chrysene	--	0.4	NOAA ERL	1.30	E3-P58-D01	Site P58 debris, Sites P31/58 drainage at Sudbury roadside	2/8
Fluoranthene	--	0.6	NOAA ERL	1.20	E3-P58-D02	Sites P31/58 drainage at Sudbury roadside	1/8

Table 6-5

DETECTIONS ABOVE BACKGROUND AND PRELIMINARY SCREENING LEVELS IN SEDIMENT IN WATERSHED 5 (μg/g)

Compound	Max. Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Above Background and Screening Levels	
						Location Found	Frequency
Phenanthrene	--	0.225	NOAA ERL	1.70	E3-P58-D01	Site P58 debris and wetlands at roadside	2/8
Pyrene	--	0.35	NOAA ERL	1.80	E3-P58-D02	Sites P31/58 drainage at Sudbury roadside	1/8
α-Chlordane γ-Chlordane	-- --	0.0005	NOAA ERL (for Chlordane)	0.005 0.006	E3-A05-D01 "	Wetlands south of Site A5	1/8
Dieldrin	--	0.00002	NOAA ERL	0.038	E3-P58-D02	Site P58 debris, Sites P31/58 drainage at Sudbury roadside	2/8
Heptachlor Epoxide	--	0.005	Ontario MOE LEL	0.016	E3-P58-D02	Wetlands south of Site A5, Sites P31/58 drainage at Sudbury roadside	2/8
Lindane	0.0011	0.003	Ontario MOE LEL	0.011 (est.)	E3-A05-D01	Wetlands south of Site A5	1/8
DDD	--	0.002	NOAA ERL	0.215	E3-P58-D01	Wetlands south of Site A5, Site P58 debris, Site P58 wetlands and drainage at Sudbury roadside	4/8
DDE	0.0015	0.002	NOAA ERL	0.041	E3-P58-D01	Wetlands south of Site A5, Site P58 debris	3/8
DDT	--	0.001	NOAA ERL	0.037	E3-P58-D01	Wetlands south of Site A5, Site P58 debris	3/8
TPHC	16.6	2 1,000	Ontario MOE LEL MCP GW-1/S-1 soil value	1,800	E3-P58-D01	Site P58 debris, Sites P31/58 drainage at Sudbury roadside	2/2 1/2

[1]NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.
[2]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[3]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[4] L = Result biased low.
[5] J = Value is estimated.

Source: Ecology and Environment, Inc. 1994.

6.1.3 QA/QC Program Analysis of Results for Watershed 5

This section provides a summary of the results of the QA/QC review performed using the protocol described in Volume I, Section 5.3.3.

Data for Watershed 5 were evaluated for usability by reviewing laboratory and field QC sample data for contamination possibly introduced into field samples by either sampling or analysis procedures. First, method blanks were reviewed for each analyte in the 96 lots associated with Watershed 5, followed by trip blanks and then rinsate blanks. Following consideration of laboratory and field QC blank samples data, laboratory flagging codes and USAEC data qualifiers were evaluated with laboratory control charts for each lot and sampled for quality assurance problems. Analytical results were then reviewed for precision through consideration of the RPD between each sample/duplicate pair and MS/MSD sample set.

Following is a discussion of samples for each site affected by QA/QC evaluation. Samples with contamination also found in the blank were qualified either with a "B" usability code for "present in the blank" or a "K" usability code for a result-biased high. Samples considered to have quality assurance problems were qualified with either an "L" usability code for a result-biased low or "R" for rejected. Samples exhibiting either high or low recoveries were qualified with a "J" usability code for estimated or "R" for rejected. Appendix F provides a list of all QC summary data for method blanks, trip blanks, rinsate blanks, field duplicate samples, and MS/MSD samples.

6.1.3.1 Site A5 - Solvent Waste Dump

Method blank contamination was observed for seven samples for one or more of the following analytes: acetone and methylene chloride from common laboratory contamination, dieldrin from laboratory equipment carryover, and zinc from the standard matrix. In addition, two samples (MF0501X1 and DXA05011) were affected by the following analytes found in rinsate samples: aluminum and antimony from particulates smaller than the 0.45 micron filter used for filtering, and potassium and zinc from the source water which were found in rinsate samples. The only analytes found in trip blank samples were acetone and methylene chloride which are attributable to common laboratory contamination.

Endrin, β-endosulfan, and lindane were also found in either the method blank or the rinsate blank at concentrations such that sample DXA05011 may have been biased high for these analytes because of their presence of these analytes in the blanks. As a result, this sample was qualified as biased high for these analytes.

Aluminum was the only analyte for which duplicate precision criteria was exceeded. As a result, samples MX0501X1, MXA05061, MXA05241, and MXA05441 were qualified as estimated for aluminum.

Aluminum in one sample (DXA05011) was qualified as estimated due to a high matrix spike recovery, while magnesium and mercury were the only analytes for which one sample (WXA05011) was qualified as estimated due to low matrix spike recoveries.

6.1.3.2 Site P31 - Old Dump

At Site P31, thirteen samples were affected by blank contamination from the following analytes: α–endosulfan, aluminum, beryllium, methylene chloride, dieldrin, endrin, endrin aldehyde, γ-chlordane, heptachlor epoxide, potassium, lindane, DDD, DDE, antimony, and zinc. In addition, nine samples were affected by rinsate blank contamination by one or more of the following analytes: aluminum, potassium, sodium, lead, antimony, and zinc. All cases of organic contamination are attributable to laboratory equipment carryover. The majority are cases of inorganic contamination, attributable to particulate matter that may have been entrained in the rinsate water.

For three samples (EXP31012, EXP31021, and EXP31031), results for β–endosulfan, DDD, DDE, α-endosulfan, dieldrin, and endrin aldehyde were biased high due to the method blank. For these and five additional samples, potassium, zinc, and sodium may also have been biased high in sample data because of rinsate blank contamination.

After reviewing duplicate pair precision data, nine samples (EDP31012, EXP31011, EXP31012, EXP31021, EXP31022, EXP31031, MDP31012, MXP31011, and MXP31012) were qualified as estimated for one or more of the following analytes: α-BHC, aluminum, arsenic, barium, iron, magnesium, nickel, vanadium, and zinc.

There were no samples for which MS/MSD samples exceeded precision criteria.

6.1.3.3 Site P40 — Building T452

There were only three analytes found in either the method or rinsate blanks associated with Site P40. Beryllium and zinc found in the method blanks affected data for only three samples (MXP40291, MXP40391, and MXP40EH1). In all cases, data for these analytes were qualified as found in the blank and are attributable to the analytical reagents. Silver was the only analyte found in any of the rinsate blank samples and affected only one sample (MXP40291).

Sample MXP40391 was the only sample for which data was qualified as biased high from method blank contamination. No samples were biased due to rinsate contamination.

Aluminum was the only analyte for which four samples (MXP40291, MXP40381, MXP40391, and MXP40EH1) were qualified as estimated due to an exceedance of duplicate precision criteria.

No other data from Site P40 was qualified.

6.1.3.4 Site P58 — Sudbury Road Dump

Blank contamination was found for 20 analytes in 22 samples. From method blank contamination, analytes of concern included: aluminum, aldrin, bis(2-ethylhexyl)phthalate, β-endosulfan, methylene chloride, dieldrin, endrin, endosulfan sulfate, potassium, sodium,

lead, and zinc. From rinsate blanks, 1,3-dinitrobenzene, 3-nitrotoluene, acetone, aluminum, ca dmium, methylene chloride, heptachlor, potassium, sodium, DDT, antimony, and zinc were analytes of concern. In all cases, these analytes were qualified as found in the blank for these samples.

Aldrin, dieldrin, potassium, sodium, lead, and DDT were also found in the method blanks at concentrations above comparison levels. As a result, eight samples also contained analytes which were qualified as biased high.

After review of precision based on duplicate pair samples RPDs, only phosphate and aluminum were found to be outside RPD control limits. As a result, five samples were qualified as estimated for these analytes.

Only one sample (MXP58012) from Site P58 was qualified as estimated due to high recoveries in the matrix spike for mercury.

No other data associated with Site P58 was qualified due to QA/QC issues.

6.2 SITE DESCRIPTIONS AND ASSESSMENTS

6.2.1 Site A5 — Solvent Waste Dump

Site A5 was identified in interviews with Natick Laboratory employees in 1980 as an area that had been used for the disposal of laboratory solvents (USATHAMA 1980). The site map is presented as Figure 6–2.

6.2.1.1 Site Location

Site A5 is about 800 feet north of the southern intersection of Patrol Road and White Pond Road. A dirt road diverges east from White Pond Road and then, within 200 feet, splits into two roads. Most of Site A5, including the terrain between the two roads, is forested. There are sand mounds on the northern and southern sides of the access road. There is also a 6 foot by 12 foot trench, 4 feet deep with a 4 foot slope, just west of well DM6. A small debris pile lies west of the site near White Pond Road.

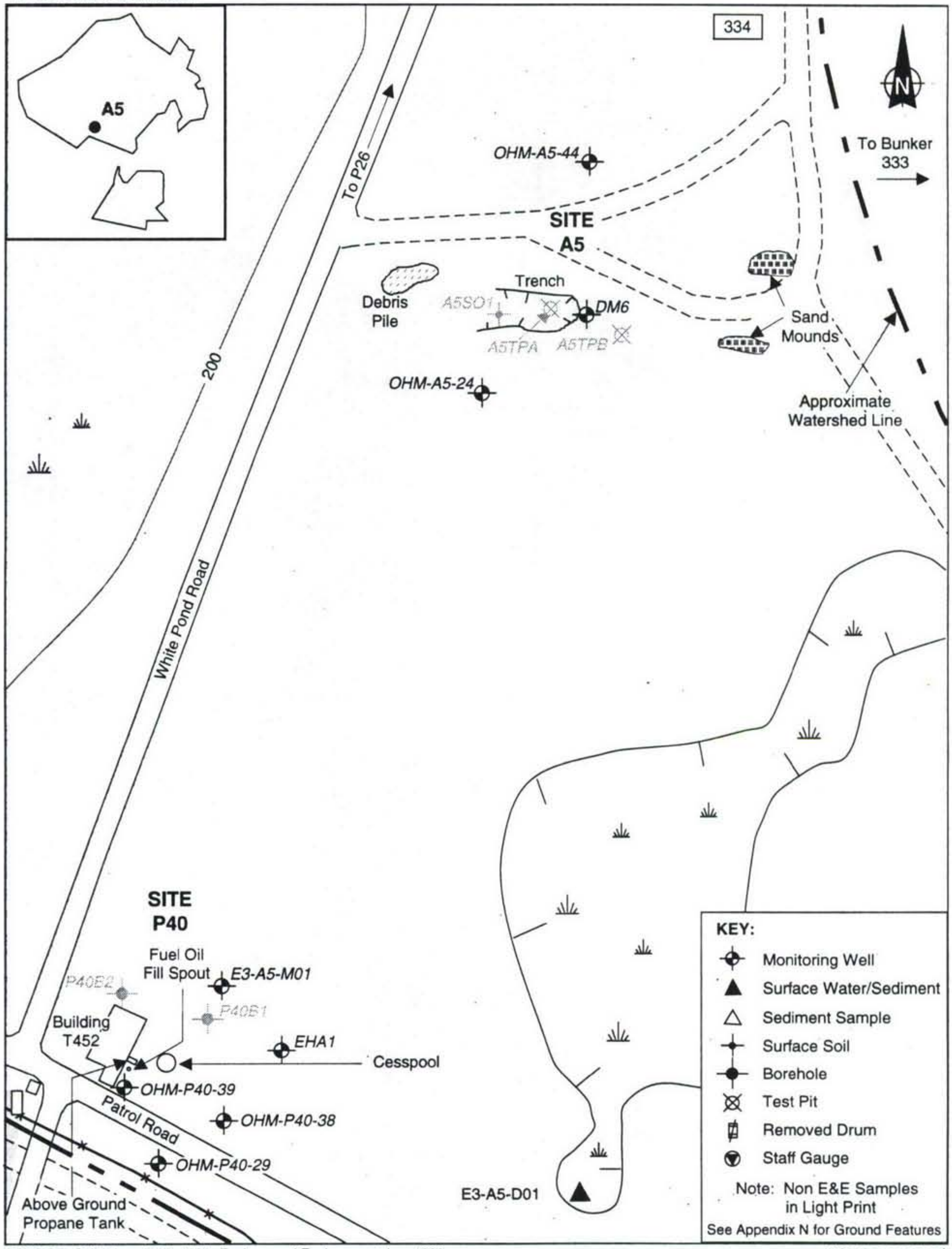
6.2.1.2 Physical Characteristics

Site A5 is on a glacial outwash plain of sand and gravel at an average surface elevation of 205 feet AMSL. The groundwater elevation is approximately 196 feet AMSL. A single boring (OHM-A5-6PH) installed by OHM in 1992 indicates that the coarse outwash extends to a depth of approximately 24 feet, with an increased fraction of fine soils beginning at 16 feet BGS. From 24 to 90 feet BGS, a dense, gray silt with fine sand was encountered. This stratum is probably representative of a glaciolacustrine environment. A relatively thin layer of glacial till extends from 90 to 102.5 feet where a fine-grained schist classified as Marlboro Formation was encountered. Grain size and Atterberg limits analyses were performed on soil samples collected from the 9 to 11 foot and 49 to 51 foot intervals at monitoring well E3-A5-M01. The sample from the 9 to 11 foot interval was identified as non-plastic, poorly graded sand, and the sample from the 49 to 51 foot interval was identified as non-plastic silt. In addition, a geotechnical analysis was performed on sediment sample E3-A05-D01. The sediment was subsequently classified as non-plastic, silty sand. Please refer to Appendix D for a summary of geotechnical results.

An average transmissivity of 500 feet^2 per day was calculated by OHM for the three monitoring wells (OHM–A5–24, OHM–A5–44, and DM6) within the site boundaries. This transmissivity was calculated by using an average conductivity for the three wells and assuming a uniform aquifer thickness of 15 feet across the site. This thickness value is approximately equal to the length of the water column within the more permeable upper outwash strata. The deepest of the three wells reached a maximum depth of 21.19 feet.

In addition to the existing wells, a 50-foot monitoring well (E3–A5–M01) was installed by E & E in 1993 approximately 800 feet southwest (downgradient) of the defined site. This well was placed at the northern boundary of the Site P40 clearing to intercept any contaminant plumes migrating from Site A5. In this well, the screened interval was set within

11: SUDBURY\UC6_540.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 6-2 MAP OF SITE A5 SOLVENT WASTE DUMP

the glaciolacustrine, dense gray silt. Transmissivity at this location was calculated to be 24.37 feet^2 per day, assuming the aquifer thickness to be equal to the length of the water column within the well. The transmissivity was calculated as follows:

$$T = Kb$$
$$T = (0.6248)\ (39.00)$$
$$T = 24.37 \text{ feet}^2 \text{ per day}$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer thickness (feet)

Complete slug test data and interpretation can be found in Appendix G. This number is indicative of a less conductive layer relative to the overlying outwash. It is difficult, however, to make any quantitative comparisons of transmissivity data because different aquifer thicknesses were used for the two calculations and at monitoring well E3-A5-M01, approximately 8 feet of the 10 foot screened interval had been filled with silt at the time the aquifer tests were conducted, leaving only 2 feet of open screen area. The screened interval was from 40 to 50 feet BGS.

Surface water flows east from the site to the adjacent wetland areas to the west and the south, but is likely to occur only during snow melt on frozen ground, or during extreme storms. Hydrogeologic data and water-level information indicate that groundwater flow is predominantly southwest toward Boons Pond.

6.2.1.3 Ecological Characterization

Site A5 contains several mounds of sand, but is generally characterized as a white pine forest with trees that have an average height of 60 feet. However, in the northern portion of the site are younger white pine trees that range in height from 10 to 20 feet (LFS 1983).

Several wetlands are located southwest and downgradient of the site, but they begin more than 400 feet from the outermost perimeter of the site. In addition, a broad-leaved deciduous wetland has been identified upgradient, or cross-gradient (west and northwest) of Site A5 (USDOI 1977).

In general, the habitat type found at this site is upland forest. White pine provides suitable nesting and roosting for many songbirds and upland game birds and cover for numerous mammal species. Also, many wildlife species will consume the needles, buds, seeds, and bark from white pine all year long (Martin *et al.* 1951). The wetland area adjacent to the site provides food, cover, and nesting for many species of birds, mammals, reptiles, and amphibians.

No unique habitats have been identified in the general vicinity of Site A5 (NHESP 1992), nor are there any rare, threatened, or endangered species associated with this site.

6.2.1.4 Site History

In interviews with Natick Laboratory Personnel, Site A5 was identified as an area that may have been used for the burial of laboratory solvents between 1973 and 1979 (USATHAMA 1980). Disposal was carried out in trenches that were excavated for "dumping" chemicals at several locations at the Annex (Interview 1990b). Except for at Site A7, the exact location of this type of disposal activity could not be confirmed. Trenching may only have taken place at other disposal areas tentatively identified at the Annex. A small amount of canned food items was also reportedly disposed of near Site A5 in the late 1970s.

During the 1986 Dames and Moore RI (Dames and Moore 1986b), an excavated trench was observed near the westernmost bunkers (Bunkers 334 and 335). The trench, described above (6.2.1.1), was reportedly open at the time of the RI field investigation. It is unknown whether this trench was used for chemical burial.

Specific references to any buildings or organized activity at Site A5 were not found in reviews of facility maps and records. Aerial photographs from 1934 show the area to be comprised of agricultural fields which were shown to be at least partially cleared through 1982. The first file notation relevant to the site states that a road was present through the site on a 1962 facility map. Maps of areas used for forestry activity by Fort Devens in the 1980s indicate that some log collection areas may be located near Site A5.

6.2.1.5 Results of Previous Investigations

In 1984, Dames and Moore installed a shallow monitoring well (to a depth of 15 feet BGS) adjacent to the deep end (east end) of the aforementioned trench to investigate possible groundwater contamination at Site A5 (Dames and Moore 1986b). No contamination was found when this well, DM6, was sampled in 1984. Also in 1984, surface water samples were collected from the wetlands south of the site at locations ranging from 800 to 1,300 feet away and outside the area that could be affected by Site A5. These samples were analyzed for VOCs only. The only contaminant found, methylene chloride, was attributed to analytical laboratory contamination.

During investigations in 1986 and 1988, the Fort Devens EMO installed and sampled one groundwater monitoring well, EHA1. Sampling results did not indicate the presence of PCE, based upon detection limits of 4 μg/L and 6 μg/L in 1986 and 1988, respectively.

In 1992, OHM performed an SI which included an area reconnaissance, a soil-gas survey, a geophysical study, test pit excavations with subsurface soil sampling, surface soil sampling, and monitoring well installation with groundwater sampling. OHM monitoring wells are shallow (less than 25 feet deep), of PVC construction, and are screened across the water table. All samples collected from Site A5 in 1992 were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, TAL metals, and explosives. The

area reconnaissance also noted the trench near well DM6 as a large sand pile on the opposite side of the well. Very little scrap metal or other surface debris was found.

The soil-gas survey was conducted as part of the OHM effort to determine the extent of contamination from the alleged solvent dumping in the area. Total Flame Ionization Detector (FID) volatiles were found at 18 locations during this survey. PCE was detected in three samples at concentrations of 0.12 μg/L to 0.41 μg/L.

Surface soil sample A5S01 was taken from the bottom of the trench where PCE was detected in the soil-gas survey. No PCE was detected in this soil sample, and the only organic compounds found in the sample were unknowns which were not identified by the laboratory.

During the OHM field effort, a geophysical study revealed numerous small magnetic anomalies caused by scrap metal such as sign posts and tent stakes. Two magnetic anomalies were further investigated by subsequent test pit excavations. The test pits uncovered metal food cans containing wheat and meat and scraps of piping, foam, and pieces of body armor. Subsurface soil samples were taken during test pit excavation. PCE was found in a soil sample (A5TPA1) from test pit A5TPA, and was the only PCE found in soil at Site A5. This sample also contained acetone, terpene, α–pinene, and numerous unknowns that may be food-related fatty acids of the same type found at Site A8 — Food Burial Ground.

Two additional shallow monitoring wells were installed and sampled in June and October 1992. Groundwater sampling showed a trace of heptachlor epoxide once in well OHM–A5–44, methylene chloride (7.8 μg/L) in the same well upon resampling, and di–*n*–butyl phthalate (5.1 μg/L) in OHM–A5–24 in one of two sample rounds. Metals were found in filtered groundwater samples in all wells at levels which were not elevated. When compared to background data, copper and zinc were found to be elevated in the groundwater from DM6 in October 1992.

6.2.1.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigations, with the exception of the geotechnical samples, were analyzed for TCL organics and TAL metals. In addition, a soil sample collected from the screened interval in well E3-A5-M01, and a sediment sample associated with Site A5, were both analyzed for TOC. The Phase II Sampling Effort for Site A5 is summarized in Table 6–6.

Groundwater Sampling

To further characterize groundwater quality at Site A5, E & E installed, developed, and sampled one deep, overburden monitoring well (E3–A5–M01). The well was completed southwest of the Site A5 clearing, along the northern border of the clearing at Site P40. It is

Table 6-6

PHASE II SAMPLING EFFORTS AT SITE A5 — SOLVENT WASTE DUMP

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	5	09/02/93 09/17/93 04/25/94	To investigate the potential for contaminant migration in the groundwater pathway.
Subsurface Soil	1	08/10/93	Geotechnical sample for grain size and Atterberg limits analyses.
	1	08/10/93	Sample sent for Total Organic Carbon analysis.
Surface Water	1	09/20/93	Samples collected to assess the potential for contaminant migration through the surface water pathway.
Sediment	1	09/20/93	
	1	09/20/93	Geotechnical samples for grain size and Atterberg limits analyses.

Source: Ecology and Environment, Inc. 1994.

screened in the overburden across an interval 40 to 50 feet BGS. In September 1993, the newly installed well and the three previously installed monitoring wells were sampled to assess groundwater quality and the potential for off-site contaminant migration. The pre-existing wells were OHM-A5-24, OHM-A5-44, and DM6. Both filtered and unfiltered groundwater samples were collected from E3-A5-M01.

In an approved deviation from the original work plan, E & E sampled the newly installed well (E3-A5-M01) only once, during the first round of groundwater sampling. The well was not sampled a second time due to the high levels of silt built up in the well since installation and the previous sampling, resulting in a blocked screen interval. The required purge volume could not be removed from the well and, according to USAEC requirements, the well could not be considered usable as a monitoring well.

Well DM6 was resampled in April 1994, to confirm the earlier results.

Subsurface Soil Sampling

During the monitoring well installation of E3-A5-M01, subsurface samples were collected from the top of the saturated zone and analyzed for TOCs. Geotechnical samples were also collected for grain size and Atterberg limits analyses, to help in assessing subsurface soil characteristics and their impact upon groundwater hydraulic conductivity.

Surface Water and Sediment Sampling

One surface water and one sediment sample were collected from the wetlands located downgradient and southeast of Site A5. The samples were collected near the southern edge of the wetlands bordering Patrol Road at a point 450 feet east of Building T452 at Site P40 to assess the potential for contaminant migration from surface drainage entering the wetlands.

Geotechnical samples were collected during sediment sampling for grain size and Atterberg limits analyses.

6.2.1.7 Nature and Extent of Contamination

In the first round of groundwater sampling in September 1993, a notable result was the detection of PCE (8.60 μg/L) in monitoring well DM6 near the center of Site A5. This level is above the SDWA MCL of 5 μg/L. PCE was also detected in a second round of sampling in April 1994, at well DM6 at a level (5.40 μg/L) above the SDWA MCL. PCE was previously detected by OHM during a soil-gas survey at three locations at Site A5 and at low levels in one soil sample taken from test pit A5TPA, which was excavated directly west of well DM6. PCE was not detected in previous sampling of groundwater at DM6 in 1984 or in 1992. PCE was also not detected in E & E sampling at wells E3-A5-M01, OHM-A5-24, or OHM-A5-44. A summary of detections above preliminary screening levels for the site is presented in Table 6-7. The analytical data for Site A5 is summarized in Tables 6-8, 6-9, 6-10, and 6-11, which follow the discussion of this site.

Monitoring well EHA1 was sampled by USAEHA in 1983, by Dames and Moore in 1984, and by OHM in 1992. The highest concentrations of PCE found each time were 22 μg/L, 30 μg/L, and 2.7 μg/L, respectively. EHA1 was installed and sampled out of concern that solvents could potentially be migrating from Site A5 southward in the groundwater. PCE was not detected in sampling of well EHA1 by Fort Devens in 1986 and 1988 based on detection limits of 4 μg/L and 2 μg/L, respectively.

The history of PCE detection at Site A5 is inconsistent with what would be expected from the disposal of large amounts of solvents at the site. However, given the positive detection of PCE in well DM6 and the previous detections of PCE in well EHA1, some limited solvent dumping might have occurred at Site A5. PCE was not detected in other wells downgradient from Site A5 (at Sites P40, P31, or P58) indicating that migration of PCE off the Annex is probably not occurring.

Metals were also detected in the four monitoring wells related to Site A5. The maximum metal values detected for all metals except antimony were from sampling of the newly installed deep well, E3–A5–M01. In the unfiltered sample collected from this well, the levels of aluminum, arsenic, beryllium, cadmium, chromium, iron, lead, manganese, nickel, and thallium were all above groundwater screening values. In particular, arsenic (69.1 μg/L) and lead (150 μg/L) were above the Massachusetts MCL levels of 50 μg/L for arsenic, and 15 μg/L for lead. Cadmium (12.9 μg/L), chromium (242 μg/L), nickel (285 μg/L), and thallium (2.19 μg/L) in the unfiltered samples were all above their corresponding SDWA MCL levels. Aluminum (70,000 μg/L), iron (120,000 μg/L), and manganese (3,500 μg/L) in the sample from E3–A5–M01 were above the MA SMCL levels for aesthetics and taste. In the groundwater samples taken at the wells closer to the suspected area of solvent disposal (DM6, OHM–A5–24, and OHM–A5–44), the only exceedances of screening levels were for aluminum, iron, and manganese, which were above the MA SMCL levels. Thus, the source of metals in the sample taken at E3–A5–M01 is not at Site A5.

Table 6-7

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE A5

Medium (Units)	Compound	Maximum Back-ground	Screen Level	Source	Maximum Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1]	--	50	MA SMCL[3]	70,000	E3-A05-M01	4/4
	Aluminum(F)[2]	--			89.1	E3-A05-M01	0/1
	Arsenic(U)	--	50	MA MCL[4]	69.1	E3-A05-M01	1/4
	Arsenic(F)	--			6.98	E3-A05-M01	0/1
	Beryllium(U)	--	4	SDWA MCL[5]	4.85(J)[9]	E3-A05-M01	1/4
	Beryllium(F)	--			<5.00	E3-A05-M01	0/1
	Cadmium(U)	--	5	SDWA MCL	12.9	E3-A05-M01	1/4
	Cadmium(F)	--			<5.00	E3-A05-M01	0/1
	Chromium(U)	--	100	SDWA MCL	242(K)[10]	E3-A05-M01	1/4
	Chromium(F)	--			<10.00	E3-A05-M01	0/1
	Iron(U)	--	300	MA SMCL	120,000	E3-A05-M01	4/4
	Iron(F)	--			1400	E3-A05-M01	1/1
	Lead(U)	--	15	MA MCL	150	E3-A05-M01	1/4
	Lead(F)	--			<5.00	E3-A05-M01	0/1
	Manganese(U)	--	50	MA SMCL	3500	E3-A05-M01	4/4
	Manganese(F)	--			1100	E3-A05-M01	1/1
	Nickel(U)	--	100	SDWA MCL	285	E3-A05-M01	1/4
	Nickel(F)	--			<10.0	E3-A05-M01	0/1
	Thallium(U)	--	2	SDWA MCL	2.19	E3-A05-M01	1/4
	Thallium(F)	--			<2.0	E3-A05-M01	0/1
	PCE	--	5	SDWA MCL	8.60	E3-A05-M01	1/4
SW (μg/L)	Arsenic	3.15	0.018	MA CWA WQC[6] (Health-H20 & Fish Cons.)	1.45(J)	E3-A05-D01	1/1
	Lead	10.3	3.2	WQC (Aq.Life)	80.7	E3-A05-D01	1/1
SED (μg/g)	α-Chlordane	--	0.0005	NOAA ERL[7]	0.005	E3-A05-D01	1/1
	Endrin	--	0.00002	NOAA ERL	0.022(K)	E3-A05-D01	1/1
	Endrin Ald.	0.0062	0.00002	NOAA ERL	0.019	E3-A05-D01	1/1
	γ-Chlordane	--	0.0005	NOAA ERL	0.006	E3-A05-D01	1/1
	Heptachlor Epoxide	--	0.005	Ontario MOE LEL[8]	0.007	E3-A05-D01	1/1
	Lindane	0.0011	0.003	Ontario MOE LEL	0.011(K)	E3-A05-D01	1/1
	DDD	--	0.002	NOAA ERL	0.582	E3-A05-D01	1/1
	DDE	0.0015	0.002	NOAA ERL	0.118	E3-A05-D01	1/1
	DDT	--	0.001	NOAA ERL	0.040	E3-A05-D01	1/1

[1] U = Unfiltered groundwater sample.
[2] F = Filtered groundwater sample.
[3] MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4] MA MCL = Massachusetts Maximum Contaminant Level.
[5] SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
[6] MA CWA WQC = Massachusetts Clean Water Act Water Quality Criteria.
[7] NOAA ERL = National Oceanographic and Atmospheric Administration Effects-Range Low.
[8] Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[9] J = Value is estimated.
[10] K = Result biased high.

Source: Ecology and Environment, Inc. 1994.

Since well E3–A5–M01 was screened in silt, the metals detected might reflect the silt in the sample and therefore the natural levels in the aquifer. Results from the filtered sample at E3–A5–M01 confirm that the elevated metals in the unfiltered sample are due to the presence of suspended solids in the groundwater sample. The only exceedances of screening values in the filtered sample were for aluminum, iron, and manganese, all of which are above the MA SMCL levels. It should be noted that it is not possible to construct a drinking water well in this interval due to the fine-grained nature of the material encountered in this water bearing zone.

Analysis of the surface water sample (E3–A5–D01) taken at the southern end of the wetlands, downgradient and southeast of the site indicated the presence of lead and of several metals slightly elevated above background levels for streams at the Annex. Lead was found in surface water at a concentration of 80 μg/L, approximately eight times the concentration detected in background samples, and lead is also above the level specified (3.2 μg/L) in the Massachusetts CWA AWQC for the protection of aquatic life. The low level of lead (24.2 μg/g) in the underlying sediments and its high TOC (427,000 μg/g), make the reported lead level in the surface water inconsistent with the sediment lead level reported, since lead from the water would be expected to sorb onto such organic-rich sediments.

The sediment sample taken in conjunction with the surface water sample was found to contain several pesticides, including α–chlordane, and DDT and its degradation products DDD and DDE, at levels above several lowest-effect level (NOAA ERL and Ontario MOE LEL) ranges for benthic organisms used as screening values. These values were also compared to the NYSDEC SQC, which allows determination of criteria on a site-specific basis. The NYSDEC criteria were adjusted for the TOC (427,000 μg/g or 42.7 percent) content of the sediment sample, and then compared to the levels detected in the sample. DDD (0.582 μg/g) was the only compound which exceeded the derived NYSDEC criteria level of 0.427 μg/g. Given the relatively low levels of these pesticides found in this sample, it is unlikely that they are indicative of site-related contamination. The probable source of these pesticides is past use of pesticides at the Annex.

6.2.1.8 Conclusions and Recommendations

The original concern at Site A5 was the possibility that solvents had been dumped previously. Sampling results do not support the hypothesis of large-scale dumping of solvents in this vicinity. However, PCE was detected at a level above the MCL value in one well (DM6), indicating the possibility of some limited solvent contamination at this site. Further, PCE was detected in 1983, 1984, and 1992 at a well (EHA1) downgradient from this site. However, PCE was not detected in EHA1 in the Fall 1993 sampling round. Surface soil, sediment, and surface water samples have not detected the presence or transport of solvents at or downgradient of the site. The residual effects of solvent dumping appear to be low levels of PCE in the groundwater near the site, with no effect on other media, or on groundwater migrating off the Annex.

The metals found in sampled monitoring wells are related to the suspended solids in the groundwater, as evidenced by the lower concentrations of metals in filtered samples.

Only aluminum, iron, and manganese concentrations exceeded secondary drinking water standards for taste and aesthetics. Aluminum, iron, and manganese were also the only exceedances of screening levels in the filtered sample. Secondary drinking water standards were promulgated to address the impact of elevated metals concentrations in drinking water in terms of taste and the staining of clothes and fixtures (sinks, baths, and toilets). These metals do not appear to be site-related contamination and probably reflect the natural background.

The lead level found in the surface water sample is significantly above Massachusetts CWA AWQC for the protection of aquatic life. While this lead data is questionable and does not confirm with the alleged potential dumping, it implies the degradation of environmental quality in the isolated wetland from samples were taken.

It is recommended that additional surface water and sediment samples be taken from within the isolated wetland southeast of Site A5 to determine whether elevated levels of lead can be confirmed and (in the event that lead is confirmed) to determine the extent of lead contamination.

It is also recommended that monitoring be continued on three wells for volatiles only: the well showing PCE (DM-6), and two downgradient wells (EHA1 and OHM-P40-39). Continued monitoring for VOCs is recommended until samples have registered below MCLs for one year.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 6-8
Chemical Summary Report For Groundwater
Site: A05
Units: UGL

Test	Site ID	DM6	DM6	DM6	E3-A05-M01	E3-A05-M01	OHM-A5-24	OHM-A5-44
	Field Sample I	MXA05061	MDA05062	MXA05062	MF0501X1	MX0501X1	MXA05241	MXA05441
	Sample Dat	09/02/93	04/25/94	04/25/94	09/17/93	09/17/93	09/02/93	09/02/93
Test	Parameter .							
TAL METAL	Aluminum	2870 J@			89.1 B@	70000 J@	7520 J@	1760 J@
	Antimony	< 5.00			5.66 B	4.11 J	< 5.00	< 5.00
	Arsenic	5.07			6.98	69.1 @	21.5	2.22
	Barium	10.6			17.1	588	25.4	15.0
	Beryllium	< 5.00			< 5.00	4.85 J@	0.402 J	< 5.00
	Cadmium	< 5.00			< 5.00	12.9 @	1.61 J	< 5.00
	Calcium	2040			9680	48600	2110	1240
	Chromium	4.65 J			< 10.0 K	242 K@	11.5	5.21 J
	Cobalt	3.60 J			3.46 J	102	6.16 J	< 10.0
	Copper	8.85 J			< 10.0	188	8.12 J	< 10.0
	Iron	2760 K@			1400 @	120000 @	8930 K@	1270 K@
	Lead	4.70 J			< 5.00	150 @	10.3	1.29 J
	Magnesium	881			2780	30600	1640	293 J
	Manganese	125 @			1100 @	3500 @	245 @	132 @
	Nickel	< 10.0			< 10.0	285 @	10.2	< 10.0
	Potassium	1090			3630	23800	1620	470 J
	Sodium	1520 J			6690	9390	2110	1490 J
	Thallium	< 2.00			< 2.00	2.19 @	< 2.00	< 2.00
	Vanadium	4.01 J			< 10.0	161	13.0	< 10.0
	Zinc	30.2 B			12.2 BJ	360	34.3 B	29.6 B
TCL VOA	Tetrachloroethene	8.60 @	5.00 @	5.40 @		< 5.00	< 5.00	< 5.00

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

\# = Exceeds ecological screening value

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. @= Exceeds human health screening value.
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. != Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 6-9

Chemical Summary Report For Subsurface Soils

Site: A05

Units: UGG

Page 1 of 1
Part 1 of 1

	Site ID	E3-A05-M01					
	Field Sample ID	BX0501X1					
	Sample Date	08/10/93					
Test	Parameter / Depth	44.0 ft.					
TOC	Total Organic Carbon	5930					

Source: USAEC IRDMIS Level 3/E & E, 1994

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 6-10
Chemical Summary Report For Surface Waters
Site: A05
Units: UGL

	Site ID	E3-A05-D01					
	Field Sample ID	WXA05011					
	Sample Date	09/20/93					
Test	Parameter						
TAL METAL	Aluminum	1000 J!					
	Arsenic	1.45 J@					
	Barium	17.4 !					
	Calcium	2220					
	Chromium	3.00 JK					
	Iron	833					
	Lead	80.7 !#					
	Magnesium	851 J					
	Manganese	390 !					
	Potassium	1390					
	Sodium	1250 J					
	Vanadium	3.34 J					
	Zinc	39.4 !					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 6-11
Chemical Summary Report For Sediments
Site: A05
Units: UGG

	Site ID	E3-A05-D01					
	Field Sample ID	DXA05011					
	Sample Date	09/20/93					
Test	Parameter .						
TAL METAL	Aluminum	2930					
	Arsenic	1.24					
	Barium	29.1 !					
	Calcium	1220 J!					
	Chromium	4.20 J					
	Copper	6.40 !					
	Iron	1310					
	Lead	24.2 !					
	Magnesium	363 J					
	Manganese	181 !					
	Nickel	3.10 J					
	Sodium	205 KJ					
	Vanadium	7.35					
	Zinc	80.1 !					
TCL Pest	Endosulfan,A	0.006 JC!					
	P,P-DDD	0.582 C#					
	P,P-DDE	0.118 C#					
	P,P-DDT	0.040 C#					
	alpha-Chlordane	0.005 JC#					
	delta-BHC	0.008 JC					
TCL VOA	Toluene	0.007 J					
TOC	Total Organic Carbon	427000					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

6.2.2 Site P31 — Old Dump / Site P58 — Sudbury Road Dump

Site P31 was originally identified in 1982 by the EPA during a review of aerial photographs that indicated a possible old dump in the area (USEPA 1982). During a reconnaissance in 1991, an additional area of dumping and debris was identified adjacent and west of a wetland area near Sudbury Road. This new area was investigated as part of Site P31 until 1993. In 1993, the dump adjacent to the wetland was designated as Site P58. Hence, these sites are discussed together in this text. The investigations are separated by their area of focus as appropriate in relation to these sites. Figure 6-3 provides the site map of Site P31 and Site P58.

6.2.2.1 Site Location

Site P31 lies approximately 400 feet northeast of Boons Pond, between Sudbury Road and White Pond Road, and also includes some areas east of White Pond Road. There are two ways to reach Site P31: the first is via White Pond Road, which diverges north from Sudbury Road at power pole 120–1/2; the second is through a parking lot on the western part of Site P31 adjacent to Sudbury Road. White Pond Road leads into the northern part of Site P31. East of the parking lot is a large, undulating sandy area that has been used as a motorcross trail and is marked with motorcycle tracks. East of White Pond Road there is an old burned area, currently revegetating. Another significant feature of Site P31 is a large pit south of the burn area. Metal debris is scattered between this pit and White Pond Road.

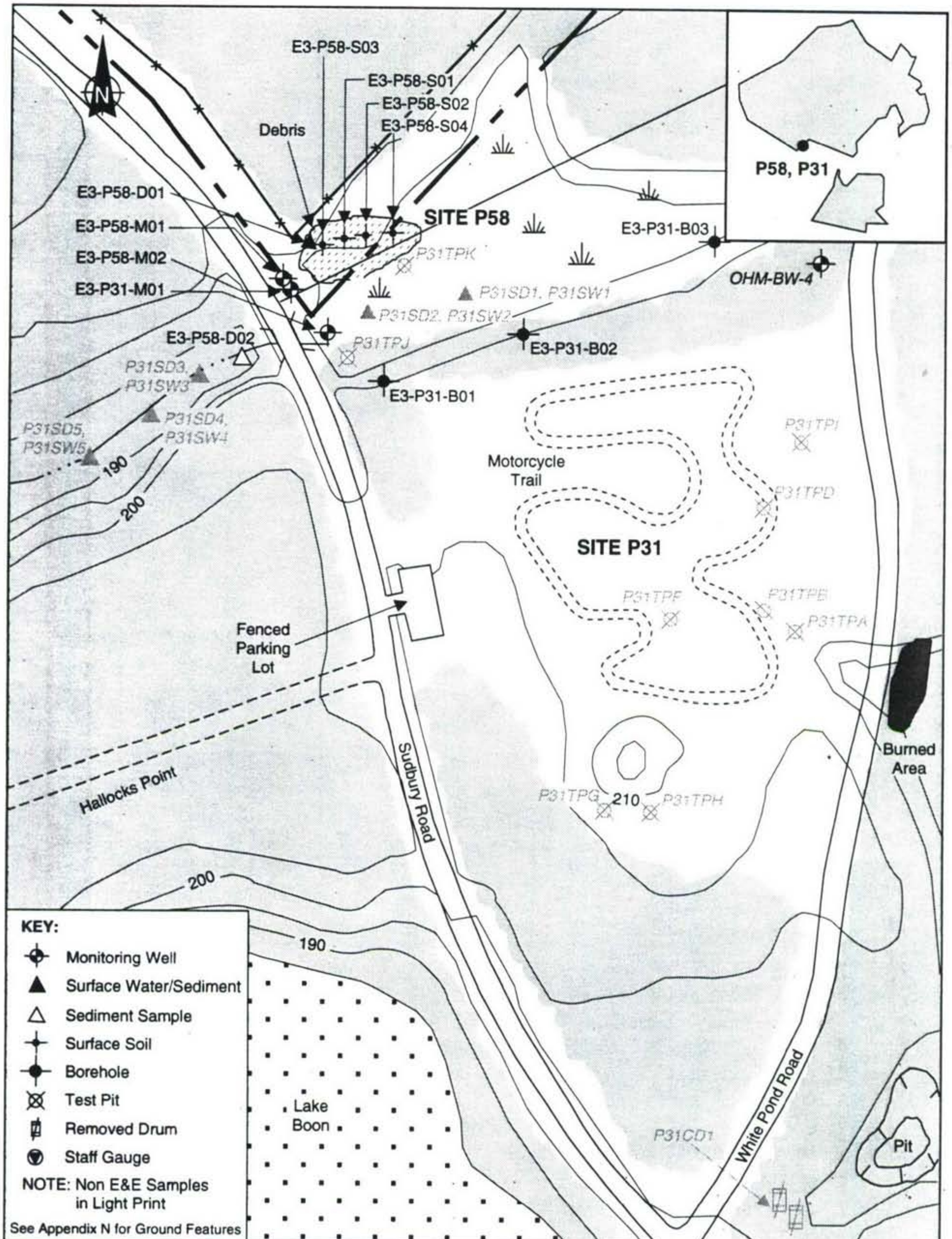
Site P58 is located immediately northwest of Site P31 and contains an exposed dump in a northeast–southwest-oriented wetland area, which is surrounded by forest. The wetland is approximately 150 yards long by 70 feet wide, and scattered metal debris is visible in various locations. A culvert on the western end of the wetland carries water under Sudbury Road to an intermittent stream that drains into Boons Pond. The Annex fence runs along the northwestern side of the dump area. The largest amount of refuse is located on the northwestern part of Site P58, just east of Sudbury Road. The debris in this muddy area is apparently household wastes and includes old bottles, pots, several batteries, rusted buckets, light bulbs, and various other metal objects. Debris is also scattered in various parts of the wetland and also extends northwestward into an area inside the facility fence.

6.2.2.2 Physical Characteristics

Sites P31 and P58 lie on an area of glacial outwash adjacent to a small wetland separating the sites and extending to the north. Surface elevations across both sites range from 195 to 205 feet AMSL. The groundwater elevation is approximately 185 to 190 feet AMSL.

Subsurface exploration associated with the installation of three monitoring wells along Sudbury Road near the wetland area disclosed a thick layer of fine sand with medium sand and gravel extending to 50 feet BGS. Fine-grained material increases and gravel content decreases with depth. Grain size and Atterberg limits analyses were performed on soil samples collected during the installation of three monitoring wells (E3-P31-M01,

11: SUDBURY\UC6_5831.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 6-3 MAP OF SITE P31 OLD DUMP
MAP OF SITE P58 DUMP AREA

E3-P58-M01, and E3-P58-M02). Subsequent soil classification identified soils in the 4 to 6 foot intervals at wells E3-P31-M01 and E3-P58-M02 as silty sands exhibiting either low plasticity (Liquid limit <35) or non-plastic characteristics. Soil from the 9 to 11 foot interval at E3-P31-M01 was identified as non-plastic, poorly graded sand. Non-plastic, sandy silt was identified from 44 to 46 feet BGS at E3-P58-M01. Additional geotechnical analyses were performed on a surface soil sample and two sediment samples collected at Site P58. The surface soil sample, E3-P58-S01, was identified as silty sand with high plasticity (liquid limit 50-70). Sediment sample E3-P58-D01 was classified as non-plastic, sandy silt; sediment sample E3-P58-D02 was classified as non-plastic, poorly graded sand. Bedrock was not encountered during this exploration. It is projected to be as much as 100 feet below the surface (Perlmutter 1962), and is probably Gospel Hill Gneiss (Hansen 1956).

Monitoring well OHM-BW-4 is located along White Pond Road between Site P31 and Site P58. Geotechnical information gathered from drilling logs from this well indicate a layer of fine-to-medium sand extending to 49 feet BGS. A fine sand and silt layer, indicative of a low-energy depositional environment, was encountered from 49 to 82 feet BGS. Glacial till extended from 82 feet, giving way to competent bedrock at 94 feet BGS. Pieces of weathered bedrock collected from the final split spoon were identified by OHM as part of the Marlboro Formation.

The aquifer transmissivities for all E & E monitoring wells at Sites P31 and P58 were calculated based on the assumption that the length of the water column in each well was equal to the aquifer thickness. Transmissivity calculations were made as follows:

$$T = Kb$$

where

T = Transmissivity (feet^2 per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer thickness (feet^2)

Monitoring Well	K	b	T
E3-P31-M01	1.721	10.71	18.43
E3-P58-M01	28.99	41.61	1,206.27
E3-P58-M02	6.595	9.77	64.43

Complete slug test data and interpretation can be found in Appendix G.

Monitoring wells E3-P31-M01 and E3-P58-M02 both have a screened interval from 8 to 18 feet, groundwater elevations of 185.11 and 184.74 feet AMSL, respectively, and comparable transmissivities. Both transmissivities are indicative of low rates of groundwater flow. Monitoring well E3-P58-M01 has a screened interval from 39 to 49 feet BGS. The transmissivity calculated for this well is significantly higher than that of for the other two

wells in the vicinity, but it can still be categorized as low (less than 1,350 feet^2 per day). The difference in transmissivities can most probably be attributed to variation of strata within the different screened intervals. No transmissivity was calculated for OHM-BW-4.

Surface water at each of the sites flows into the wetland, which drains under Sudbury Road and into Boons Pond, approximately 300 feet southwest of the road. Groundwater also flows southwest toward Boons Pond, although during periods of high groundwater, discharge may be directly into surface water in the adjoining swamp.

6.2.2.3 Ecological Characterization

Site P31 appears to be a former farm site and minor dump approximately 200 to 500 feet northeast of Boons Pond, between Sudbury Road and White Pond Road. Site P31 is an open disturbed area covered with sand and scattered grasses and forbs. On the eastern perimeter of the site, there is densely vegetated oak forest with trees ranging from 40 to 60 feet in height. Motorcycle tracks over the entire sand area suggests frequent recreational use.

Site P58 is less than 100 feet northwest of the west side of Site P31 and contains an exposed dump located in a wetland identified as a broad-leaved, deciduous scrub-shrub wetland (USDOI 1977). The area surrounding this wetland is identified as a densely vegetated, white pine-oak forest, with trees ranging from 40 feet to 60 feet in height.

In addition to the wetland at Site P58, two other forested wetlands are associated with sites P31 and P58. The first is 500 feet north of Site P31 and Site P58, and is the origin of the intermittent stream that runs through the wetland, and the second adjoins Site P31 on its eastern side across White Pond Road. Both wetlands are seasonally saturated and vegetated with deciduous trees. Due to the topography of the area, however, the wetlands will not receive runoff from Site P31 or Site P58. Instead, runoff from this area will flow into the wetland associated with Site P58 and will drain into Boons Pond, 600 feet to the southwest, via a culvert under Sudbury Road.

Three distinct habitats occur in this area: upland forest, scrub-shrub forested wetland and open area. Oak and pine provide nesting and roosting areas for songbirds and game birds. Pine seeds, oak acorns, buds, twigs, and leaves are consumed by small mammals, game birds, and songbirds (Martin *et al.* 1961). The open disturbed area at the site is not expected to be frequented by wildlife mostly because of substantial human activity and noise around the site. Furthermore, the sand area provides little cover and only scattered grasses as food.

Scrub-shrub wetlands such as the one associated with Site P58 are usually very productive habitats that support a variety of semi-aquatic and aquatic species and also provide nesting and roosting areas to many ground-nesting birds and waterfowl. However, noise and activity on the adjacent Sudbury Road is likely to discourage birds from using this site as a nesting area.

No unique habitats have been identified around Sites P31 and P58 (NHESP 1992),

nor are there any rare, threatened, or endangered species associated with these sites.

6.2.2.4 Site History

As explained earlier, Site P31 initially included the area that has been reclassified as Site P58. The histories of both Site P31 and Site P58 are discussed together in this section.

Site P31 was identified by the EPA in 1982. A 1939 aerial photograph found by the EPA shows several buildings located in and around Site P31, and several structures and a field area, possibly part of a farm or homestead, were also noted in the Site P31 area. Site P58 was partially cleared and several paths or roads entered from the east side and Sudbury Road. A 1942 facility map identified a series of buildings, Building T117, Building T118, Building T119, and Building T120, behind a fence line along Sudbury Road in the northern part of Site P31 or the southern part of Site P58. These buildings do not appear on any other maps of the Annex, and were probably there prior to Army assumption of the land in the early 1940s.

Site P31 appears cleared in aerial photographs from 1944, 1952, and 1963. Site P58 appears cleared in a 1952 aerial photograph, but in aerial photographs from 1963 and 1978 there is evidence of vegetation.

In a 1955 map, Building T454 appears in Site P31 along Sudbury Road. This building was apparently a dwelling that predated Army assumption of the Annex. A note on the map seemed to indicate that either Building T454 was improperly located in earlier maps as west of the wetland area or the structure was moved to its new location between the wetland area and White Pond Road. In 1958, 23.8 acres of the Annex, including all of Site P31, were leased to the Arctic Construction and Frost Effects Laboratory (ACFEL) of the USACE for use as a "Heavy Load Test Area." A joint use agreement between the USACE and the Quartermaster Research and Engineering Command at Natick indicated that the lease included use of Building T454. The plan was to construct a 30 foot by 50 foot pilot test section, which would be frozen from the ground surface down for use in a test to clarify and identify problems to be expected in construction and operation of a larger-scale artificial refrigeration mat. This was to be used in controlled freezing operations for field tests to be conducted in the Arctic. Once test sections were frozen, they were to be subjected to traffic using heavy gear loads. In connection with use of Site P31, the USACE also leased Bunkers 328, 329, and 330. In 1960, the USACE notified the Quartermaster Research and Engineering Command that they no longer needed Site P31. It is unknown exactly what activities were actually conducted by the USACE at Site P31 between 1958 and 1960. No other structured activity related to Site P31 was identified after 1960.

Site P31 was part of land excessed in 1978 that became the property of the Massachusetts State Parks Department. It is currently used by recreational motorcycle and bicycle riders. The southeastern half of Site P58 was part of the land excessed in 1978; the northwestern portion remained property of the Annex.

6.2.2.5 Results of Previous Investigations

A site reconnaissance was performed by representatives of Dames and Moore, USAEC, Fort Devens, and the MADEQE in 1985 to investigate sites identified earlier by the EPA from aerial photographs in 1982. Much of the area (likely to be only Site P31) was observed to be burned and appeared to have been part of a farm at one time. Limited quantities of household refuse and building material were found dumped in the area.

In April 1991, OHM collected for the USAEC a surface water/sediment sample from the drainage/wetland area (called the "small wash") that crosses between Site P31 and Site P58, as reported (OHM 1994) without further reference. The exact location of this sample has not been determined. The surface water sample contained barium (30.3 μg/L), iron (1,370 μg/L), manganese (221 μg/L), and zinc (42.8 μg/L). The sediment sample contained acetone (0.9 μg/g), lead (1,200 μg/g), barium (303 μg/g), iron (60,000 μg/g), and zinc (2,010 μg/g). All of these concentrations were elevated in comparison to other surface water and sediment samples collected from other locations at the Annex (OHM 1994).

A report entitled "Site Investigations at the Fort Devens Sudbury Annex", dated January 8, 1992, by Scott Harrington and Susan Gouche, cited (but not referenced) by OHM in its 1994 SI/RI report, presented data from five soil samples and two surface water samples collected from the drainage/wetland area (called the "small wash" in the report). It is not known who collected these samples. The most highly concentrated metals found in the soil were barium (21 μg/g), chromium (17 μg/g), and lead (26 μg/g). For the water samples, barium (66 μg/L) and lead (60 μg/L) were also the most highly concentrated. Graphite furnace atomic absorption indicated 50 μg/L and 6.8 μg/L of lead (OHM 1994).

An SI was performed by OHM at Site P31 in 1991 and 1992, in which the Sudbury Road dump (Site P58) was investigated as part of Site P31. Activities included an area reconnaissance, a geophysical study, test pit excavation with subsurface soil sampling, surface water/sediment sampling, installation of a site boundary well and groundwater sampling, and the removal of two, empty 55-gallon drums and confirmatory sampling. All samples were tested for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs explosives, and phosphate.

The site reconnaissance of Site P31 in 1991 located many soil mounds and pits. There are likely from motorcycle activity, small asphalt piles in the northern portion of the site, and scattered debris across both sites, including bottles, cans, and scrap metal. A stone foundation lies in the northeast portion of Site P31. A geophysical study at Site P31 that used EM, magnetic, and scanner magnetometry (SM) techniques identified several anomalies. Seven test pits were excavated at the site based on the results of the study, uncovering a large amount of debris, including metal pipes, ash, cinders, small boxes, nails, cloth wire mesh, metal cylinders, rusted paint cans, and a C-size battery.

Of the five test pits excavated at Site P31, sampling results indicated some low-level contamination at two test pits, P31TPB and P31TPG. Phenanthrene (0.22 μg/g), chlorobenzene (0.001 μg/g), and lead (84 μg/g) were found at the 2 to 4 foot interval in test

pit P31TPB, and may indicate a small gasoline or oil release. These contaminants were not found in the deeper sample in P31TPB taken at the 6 foot interval. The sample at the 2 to 4 foot interval also contained residues of DDT (0.115 μg/g), DDE (0.45 μg/g), and phosphate (3.29 μg/g). Three PAHs: fluoranthene (0.42 μg/g), phenanthrene (0.62 μg/g), and pyrene (0.52 μg/g) were found at the 3 foot interval in test pit P31TP6 but not at the 6 foot interval. The 2 foot depth sample from test pit P31TP6 also had elevated concentrations of barium and zinc. Aluminum and copper were found in elevated concentrations at the 3 foot depth in test pit P31TPG.

Two test pits were excavated in or near Site P58 and uncovered old trash and buried objects, including old glass bottles, sheet metal, steel cable, bricks, construction demolition debris, leather, fabric, auto parts, pipes, wiring, wood, and 5 gallon pails. Analytical results indicated lead (65.6 μg/g), acetone (0.017 μg/g), and toluene (0.003 μg/g) in samples from test pit P31TPJ and lead (76.9 μg/g) and mercury (0.151 μg/g) in samples from test pit P31TPK.

Surface water and sediment samples were taken in 1992 at various locations in the drainage that crosses Site P58 and leads to Boons Pond. These samples were taken both upstream and downstream of the culvert that crosses under Sudbury Road. The highest concentrations of zinc (52.5 μg/g) and iron (9,300 μg/g) in sediment samples were found in sample P31SD2. Lead was found at 72 μg/g in sediment sample P31SD1 and at 40 μg/g in sediment sample P31SD2. These levels were elevated above the other sediment samples taken at Site P58. The PAH phenanthrene (2.09 μg/g) and the pesticides DDD (0.19 μg/g) and endrin (0.2 μg/g) were also present in sample P31SD2.

Analysis of surface water samples found that the highest concentration of iron (3,720 μg/L) and manganese (665 μg/L) were above background, as it was in several surface water samples. In the three samples taken from the drainage southwest of Sudbury Road, sodium was found at the highest concentration (22,400 μg/L). Since this sampling was conducted at the end of April 1992, it is highly likely that the effects of winter road salting were responsible for the sodium concentrations. Zinc (36.8 μg/L) was also found in P31SW2. Sulfur (49 μg/L) and several unknown compounds were the only chemicals found in the analyses for surface water samples.

Monitoring well OHM–BW–4 was installed as a well on the Annex boundary upgradient of both Sites P31 and P58 in May 1992 and was subsequently sampled in June and October. Analysis of groundwater samples from well OHM–BW–4 indicated α–chlordane (0.033 μg/L), 4–nitrotoluene (3.77 μg/L), Cyclonite (5.51 μg/L), and acetone (17 μg/L) in June 1992, but showed nothing in October 1992. Arsenic (12.4 μg/L and 10.6 μg/L), iron, and manganese also found in the samples were elevated when compared to other boundary wells.

Removals

Two empty, crushed drums were removed in 1992 by OHM from the trench on the east side of White Pond Road across from the Marlboro State Forest sign. A drum

confirmation sample (P31CD1) was taken from the former location of the drums. The sample was collected from dark stained soil and had elevated levels of PAHs and metals. The metals found at concentrations indicative of contamination were barium, copper, nickel, manganese, zinc, iron, and lead. The concentration of lead (7,700 μg/g) was the second highest encountered at the Annex up to that date. Low concentrations of DDT, DDE, β-endosulfan, and heptachlor epoxide were also detected.

6.2.2.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation at Site P31 and Site P58, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, explosives, TPHC, phosphates, and herbicides on the drinking water standard. One surface soil sample at Site P58, the sediment samples, and the soils from the screened interval in the three wells, were all analyzed for TOC. Surface water samples collected in the area were analyzed for nitrogen content (nitrites and nitrates). The Phase II sampling effort for Sites P31/P58 is summarized in Table 6-12.

Table 6-12

PHASE II FIELD EFFORTS AT SITE P31 (OLD DUMP) AND SITE P58 (SUDBURY ROAD DUMP)

Sample Type	Site Samples		Sample Date(s)	Sampling Rationale
Groundwater	P58	4 from two rounds	09/01/93 09/02/93 12/02/93 12/03/93	Samples used to assess the potential for contaminant migration in the groundwater pathway.
	P31	2 from two rounds		
Subsurface Soil	P31	5	09/24/93	Samples used to investigate subsurface soils as source of site contamination.
	P31 P58	6	09/24/93	Geotechnical samples collected for grain size and Atterberg limits analyses.
	P31 P58	3	09/12/93	Samples collected for TOC analysis.
Surface Water	P58	1	12/02/93	Samples used to assess the potential for contaminant migration through the surface water pathway.
Sediment	P58	2	09/16/93	
	P58	2	09/16/93	Samples collected for TOC analysis.
	P58	2	09/16/93	Geotechnical samples collected for grain size and Atterberg limits analyses.
Surface Soil	P58	4	09/20/93	Samples collected to assess the nature of surface soil contamination in the area.
	P58	1	09/20/93	A geotechnical sample was collected for grain size and Atterberg limits analyses.

Source: Ecology and Environment, Inc. 1994.

Geophysical Investigations

An EM survey of Site P58 was performed to investigate the presence of any buried debris. The area surveyed is along the northwestern edge of the swamp that lies north of Sudbury Road. The survey area encompassed portions currently within the boundaries of the Annex and also a portion that was excessed by the Army in 1958. This confirmed that the area of dumping coincided with visible surface debris. See Figure 3-17, Appendix E.

Groundwater Sampling

To characterize groundwater quality, E & E installed, developed, and sampled three monitoring wells: a deep and shallow glacial outwash cluster at Site P58, and a single shallow well at Site P31. The deep well at Site P58 was screened across a depth of 39 to 49 feet BGS. The other Site P58 cluster well and the well at Site P31 were installed in the shallow glacial outwash and screened across depths of 8 to 18 feet BGS. Two rounds of samples, including both filtered and unfiltered metal samples, were collected from each of the three monitoring wells during September and December 1993.

In addition, all three newly installed monitoring wells were slug-tested to determine the hydraulic conductivity for the screened intervals of each of the wells.

Subsurface Soil Sampling

During monitoring well installation, subsurface samples were collected from the top of the saturated zone in each well and analyzed for TOC content. Samples were also collected for grain size and Atterberg limits analyses, where appropriate.

Three subsurface borings were completed along the eastern bank of the wetlands at Site P31 The borings were completed with a gas-powered hand auger. Two samples were collected from borings E3-P31-B01 and E3-P31-B02 at approximate depths of 0 to 2 feet BGS and 3 to 5 feet BGS. Due to the proximity of the wetlands and the relatively high groundwater level in boring E3-P31-B03, only one subsurface soil sample was collected from a depth of 0 to 2 feet BGS. Samples were collected from each boring and sent for grain size and Atterberg limits analyses, as appropriate.

Surface Water and Sediment Sampling

Two locations downgradient of the suspected dump area were sampled to characterize the impacts, if any, of surface runoff leaving the sites and entering the downgradient wetlands. The wetlands act as a runoff catchment basin and channeling point for drainage from the sites southwest to Boons Pond. During a relatively dry period in September 1993, only two sediment samples without accompanying water samples could be collected. However, a surface water sample was collected at the location north of Sudbury Road (E3-P58-D01) during the second round of groundwater sampling in December 1993. This surface water sample was analyzed for total nitrogen (nitrite and nitrate) contents. An

additional sediment sample was collected at locations E3-P58-D01 and E3-P58-D02, for grain size and Atterberg limits analyses, as appropriate.

Surface Soil Sampling

Four surface soil samples were collected from locations in suspected runoff pathways or from visibly stained or disturbed locations along the banks of the wetland area. The sample information will be used to characterize the impacts, if any, that past disposal activities may have had upon the wetlands and downgradient areas. One surface soil sample, E3-P58-S01, was sent for geotechnical analysis to determine grain size and Atterberg limits.

6.2.2.7 Nature and Extent of Contamination

Analysis of groundwater, soil, surface water, and sediment samples indicates potential metals contamination of groundwater, soil, surface water, and sediments probably due to past activities and the presence of metal and debris in Site P58. Based on data from subsurface soil sampling at the northern edge of Site P31, contamination does not appear to be migrating from Site P31 into the wetland adjoining Site P58. Summaries of detections above screening levels at the site are provided in Tables 6-13 and 6-14. The analytical data for Site P31 is also provided in Tables 6-15 through 6-21 at the end of the discussion of these sites.

In the September and December 1993 groundwater sampling rounds at Sites P31 and P58, the metals found above drinking water standards included aluminum, arsenic, iron, lead, and manganese. Arsenic was detected at highest concentrations in unfiltered samples from E3-P31-M01 (up to 91.2 μg/L), but at a lower concentration in Site P58 wells (47 μg/L, maximum). The highest concentration of arsenic (66 μg/L) in the filtered samples was found in the samples from E3-P31-M01, taken in the second round of sampling in December 1993. Arsenic (12.4 μg/L) was found at lower levels during 1992 sampling by OHM of the boundary well OHM-BW-4, which is upgradient of Site P31 and Site P58. The elevated levels of other metals in the groundwater may be the combined result of naturally occurring levels and the metal debris at the site.

Trace concentrations of DDE (0.28 μg/L), β-BHC (0.050 μg/L), and δ-benzenehexachloride (0.600 μg/L) were found once in the September 1993 samples of Site P58 wells and δ-benzenehexachloride was noted again in December, but the DDE values were below screening levels and no screening values were found for any of the forms of δ-benzenehexachloride. No VOCs were noted in any of the wells at Site P31 and Site P58.

Analysis of subsurface soil samples from the three soil borings drilled on the southern bank of the wetland between Site P31 and Site P58 did not indicate the presence of elevated metals in the soil. Most of the metals found in the subsurface soil were below surface soil background levels at the Annex. Manganese (up to 129 μg/g) was found in several of the soil boring with two samples above background levels. By way of comparison, analysis of

Table 6-13

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P31/P58 GROUNDWATER AND SOIL

Medium (Units)	Compound	Maximum Back-ground	Screen Level	Source	Max. Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1] Aluminum(F)[2]	-- --	50	MA SMCL[3]	15,000 *	E3-P58-M01	3/3
	Arsenic(U) Arsenic(F)	-- --	50	MA MCL[4]	91.2 63.4*	E3-P31-M01 E3-P58-M01	1/3 1/3
	Iron(U) Iron(F)	-- --	300	MA SMCL	53,000 24,000	E3-P31 M01 E3-P31-M01	3/3 3/3
	Lead(U) Lead(F)	-- --	15	MA MCL	43.4 <5.00	E3-P58-M01 E3-P58-M01	1/3 0/3
	Manganese(U) Manganese(F)	-- --	50	MA SMCL	1,100 1,000	E3-P58-M02 E3-P58-M02	3/3 3/3
	1,3-Dinitrobenzene	--	1	EPA Health Advisories	2.29	E3-P58-M02	1/3
Subsurface Soil (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[5]	0.440(L)[7]	E3-P31-B03	1/6
Surface Soil (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1	0.428	E3-P31-S04	1/4
	Copper	10.7	2,900	Reg. III RBC[6] (Residential)	4,300(L)	E3-P58-S03	1/4
	Lead	150	300	MCP GW-1/S-1	1,300	E3-P58-S01	3/4
	Manganese	95.8	390	Reg. III RBC (Residential)	1,010	E3-P58-S03	2/4
	Zinc	44.6	2,500	MCP GW-1/S-1	2,800	E3-P58-S01	1/4
	Benzo(*a*) Anthracene	--	0.7	MCP GW-1/S-1	1.60	E3-P58-S01	1/4
	Benzo(*a*)pyrene	--	0.7	MCP GW-1/S-1	1.30	E3-P58-S01	1/4
	Benzo(*b*) fluoranthene	--	0.7	MCP GW-1/S-1	1.50	E3-P58-S01	2/4
	Chrysene	--	0.7	MCP GW-1/S-1	1.50	E3-P58-S01	1/4

* = in 12/3/93 filtered GW sample at E3-P31-M01.
[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MA MCL = Massachusetts Maximum Contaminant Level.
[5]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[6]Reg III RBC = EPA Region III Risk-Based Concentrations.
[7] L = Result biased low.

Source: Ecology and Environment, Inc. 1994.

Table 6-14

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P31/58 SURFACE WATER AND SEDIMENT

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Maximum Concentration	Site ID	Frequency above screen level
SW (ug/L)	Arsenic	3.15	0.018	MA/CWA WQC[1]	38.5	E3-P58-D01	1/1
	Cadmium	<5.0	1.1	MA/CWA WQC[2]	90.1	E3-P58-D01	1/1
	Chromium	<10.0	210	MA/CWA WQC[2]	1500	E3-P58-D01	1/1
	Copper	<10.0	12	MA/CWA WQC[2]	6300	E3-P58-D01	1/1
	Iron	4810	1,000	MA/CWA WQC[2]	6,900,000	E3-P58-D01	1/1
	Lead	10.3	3.2	MA/CWA WQC[2]	7300	E3-P58-D01	1/1
	Mercury	--	0.14 0.012	MA/CWA WQC[1] MA/CWA WQC[2]	5.52	E3-P58-D01	1/1
	Nickel	<10.0	610 160	MA/CWA WQC[1] MA/CWA WQC[2]	939	E3-P58-D01	1/1
	Zinc	13.3	110	MA/CWA WQC[2]	31000	E3-P58-D01	1/1
SED (ug/g)	Antimony	<0.5	2	NOAA ERL[3]	6.04	E3-P58-D01	1/2
	Arsenic	2.03	6	Ontario MOE LEL[4]	15.3	E3-P58-D01	1/2
	Cadmium	1.79	0.6	Ontario MOE LEL	28.8	E3-P58-D01	1/2
	Chromium	9.66	26	Ontario MOE LEL	131	E3-P58-D01	1/2
	Cobalt	3.74	50	Ontario MOE LEL	59.7	E3-P58-D01	1/2
	Copper	6.33	16	Ontario MOE LEL	600(L)[7]	E3-P58-D01	1/2
	Iron	7590	20,000	Ontario MOE LEL	280000	E3-P58-D01	1/2
	Lead	4.48	300 31	MCP GW-1/S-1[5] Ontario MOE LEL	950	E3-P58-D01	1/2 2/2
	Manganese	70.5	390 460	MCP GW-1/S-1 Ontario MOE LEL	963	E3-P58-D01	1/2 1/2
	Mercury	--	0.15	NOAA ERL	0.765	E3-P58-D01	1/2
	Nickel	5.92	16	Ontario MOE LEL	109	E3-P58-D01	1/2
	Zinc	20.8	120 2,500	NOAA ERL MCP GW-1/S-1	3,600	E3-P58-D01	1/2
	2-methyl naphthalene	--	0.065	NOAA ERL	0.160(J)[8]	E3-P58-D02	1/2
	Anthracene	--	0.085	NOAA ERL	0.140(J)	E3-P58-D02	1/2
	Benzo(*a*) anthracene	--	0.23	NOAA ERL	0.660	E3-P58-D02	1/2
	Benzo(*a*) pyrene	--	0.7 0.4	MCP GW-1/S-1 NOAA ERL	2.00	E3-P58-D01	1/2 2/2
	Benzo(*b*) fluoranthene	--	0.7	MCP GW-1/S-1	0.960	E3-P58-D02	1/2
	Chrysene	--	0.7 0.4	MCP GW-1/S-1 NOAA ERL	1.30	E3-P58-D01	2/2
	Fluoranthene	--	0.6	NOAA ERL	1.20	E3-P58-D02	1/2

See end of table for footnotes.

Table 6-14 (continued)

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P31/58 SURFACE WATER AND SEDIMENT

Medium (Units)	Compound	Max. Back-ground	Screen Level	Source	Maximum Concentration	Site ID	Frequency above screen level
SED (μg/L) (continued)	Phenanthrene	--	0.225	NOAA ERL	1.70	E3-P58-D01	0/2
	Pyrene	--	0.35	NOAA ERL	1.80	E3-P58-D02	1/2
	Aldrin	0.007	0.002	Ontario MOE LEL	.004	E3-P58-D01	1/2
	Dieldrin	--	0.03 0.00002	MCP GW-1/S-1 NOAA ERL	0.038	E3-P58-D02	1/2 2/2
	γ-Chlordane	--	0.0005	NOAA ERL	0.003	E3-P58-D02	1/2
	Heptachlor Epoxide	--	0.003	EPA SQC[6] (for Heptachlor, @2.62% TOC)	0.016	E3-P58-D02	1/2
	DDD	--	0.002	NOAA ERL	0.019	E3-P58-D02	1/2
	DDE	0.0015	0.002	NOAA ERL	0.041	E3-P58-D01	2/2
	DDT	--	0.001	NOAA ERL	0.037	E3-P58-D01	2/2
	TPHC	16.6	500	MCP GW-1/S-1	1800	E3-P58-D01	1/1

[1]MA CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for protection of human health re: consumption of water and fish.
[2]MA CWA WQC = Massachusetts/Clean Water Act Water Quality Criteria for protection of aquatic life.
[3]NOAA ERL = National Oceanographic and Atmospheric Administration Effects Range Low.
[4]Ontario MOE LEL = Ontario Ministry of the Environment Lowest Effect Level.
[5]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.
[6]EPA SQC = EPA Sediment Quality Criteria.
[7] L = Result biased low.
[8] J = Value is estimated.
Source: Ecology and Environment, Inc. 1994.

subsurface soil samples taken at a test pit located directly in the wetland area by OHM in 1992 had indicated concentrations of lead (76.9 μg/g, maximum) and mercury (0.151 μg/g, maximum) above background levels. (See Section 6.2.2.5 p. 6-35).

Trace concentrations of several pesticides were also found in the soil boring samples, most below the maximum level found in background surface soil samples. No VOCs were found in subsurface soil samples taken at the three borings. TPHC was also found in two of the borings, the highest concentration (11.4 μg/g) of which was below the MCP GW-1/S-1 soil level of 500 μg/g.

The four surface soil samples taken by E & E were all located in the main area of debris at Site P58. Analysis of these samples showed several metals and PAH compounds at concentrations above screening values and trace levels of pesticides. The concentration of copper (4,300 μg/g) at E3-P58-S03, lead (1,300 μg/g) and zinc (2,800 μg/g) at E3-P58-S01, and manganese (1,010 μg/g) at E3-P58-S03 were all above screening and comparison values selected for the four metals; EPA Region III RBC level for residential soil for copper (2,900

μg/g); MCP GW-1/S-1 value for lead (300 μg/g), EPA interim cleanup value for lead (500 μg/g), MCP GW-3/S-3 value for lead (600 μg/g); EPA Region III RBC for residential soil for manganese (390 μg/g); and MCP GW-1/S-1 value for zinc (2,500 μg/g). Arsenic levels in surface soil surveys were below the highest arsenic concentrations in background soils.

Various PAH compounds, including benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, and chrysene, were all found in one soil sample at E3-P58-S01 above the MCP GW-1/S-1 and MCP GW-3/S-3 soil level for all four compounds of 0.7 μg/g. These may indicate burning of fuel or other petroleum products in the immediate area surrounding this sample location. Pesticides were also found in the soil samples, but at concentrations comparable to background levels. A trace level of methoxychlor (0.024 μg/g) was found in one sample at E3-P58-S04. No methoxychlor was detected in background samples, but this level is far below the MCP GW-1/S-1 soil value of 100 μg/g.

One sediment sample (at E3-P58-D01) was collected from the middle of the dump at the northwest edge of the wetland at Site P58. Another sample (at E3-P58-D02) was collected from the drainage across from Sudbury Road leading down to Boons Pond. This can only be adequately discussed in conjunction with the OHM samples collected at Site P31 in 1992. Sample location P31SD1 is directly across the tiny wetland, about 60 feet from the middle of the dump where E3-P58-D01 is located, but it shows a sharp contrast in the level of contamination present. No organics were identified in P31SD1 despite a TOC content of 2.5 percent. In contrast, six PAHs were detected in E3-P58-D01 sediment: benzo(*a*)pyrene, chrysene, fluoranthene, naphthalene, phenanthrene, and pyrene. Benzo(*a*)pyrene at 2.0 μg/g and chrysene at 1.3 μg/g exceeded the health-based screening values. Other organics noted include a number of pesticide detections above ecological screening levels.

The metals found in the sediment sample at E3-P58-D01 also did not agree with P31SD1 results, with a very high level of iron in the E3-P58-D01 sediment sample, 28 percent, implying that much of this sample is rust, ferric oxide, or ferric hydroxide, which typically sorbs other metals. By contrast only arsenic (3.52 μg/g) and lead (72 μg/g) exceed background and screening levels in sample P31SD1. Thirteen metals other than iron in the E3-P58-D01 sediment sample exceed background, while three, lead, manganese, and zinc, exceed health-based screening values for soil. Twelve metals, antimony, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, and zinc, exceed ecological screening values for sediment. Although the TOC in the E3-P58-D01 sediment sample is high, 36.4 percent, the determining factor producing such high levels of metals is evidently the iron.

The E & E sediment sample at E3-P58-D02, across Sudbury Road, shows low levels of iron (1 percent) and TOC (2.62 percent), and much lower levels of all metals except aluminum, beryllium, and magnesium, which probably is a result of the higher mineral content of the sample. Some organics are different in the sediment sample at E3-P58-D02 than further upstream at E3-P58-D01, with increased levels of PAHs (9.921 μg/g total), compared to 4.19 μg/g in the sediment sample at E3-P58-D01. (See Table 6-21). This reflects the location of the sample, downstream of runoff from a heavily traveled road, although, surprisingly, TPHC (1,800 μg/g) is higher in the sediment at E3-P58-D01 than at

E3-P58-D02 (129 μg/g). The sediment sample from E3-P58-D02 showed, on average, even higher levels of pesticides, including 0.038 μg/g of dieldrin, which exceeded a human health risk based standard, 0.005 μg/g of endosulfan A, which exceeded background, and levels of heptachlor epoxide (0.016 μg/g), DDD (0.019 μg/g), DDE (0.015 μg/g), DDT (0.037 μg/g), and gamma-Chlordane (0.003 μg/g), all of which exceeded ecological guidelines. The three OHM sediment samples P31SD3, P31SD4 and P31SD5, were taken from locations further down the drainage towards Boons Pond. They show generally low and decreasing levels of metals, as well as much lower TOCs than in the wetland samples. Pesticides were not found in earlier OHM sediment sampling downstream of E3-P58-D02 at sample points P31SD3, P31SD4, and P31SD5.

In general, the on-site sediments do not appear to be resulting in marked off-site migration to Boons Pond, as evidenced by the declining level of contaminants found in samples taken further downstream. It is possible that the limited off-site migration is due to the low rates of flow in the wetland.

The surface water sample at P58D01 displayed 7,300 μg/L of lead, and 6,900,000 μg/L of iron in addition to elevated concentrations of aluminum (18,000 μg/L), arsenic (38.5 μg/L), cadmium (90.1 μg/L), chromium (1,500 μg/L), copper (6,300 μg/L), mercury (5.52 μg/L), nickel (939 μg/L), and zinc (31,000 μg/L), which were all above their screening values. The levels of metals in the surface water are probably caused by suspended sediment, due to the difficulty of obtaining a non-turbid sample from the very shallow water in the wetland. The level of metals in this sample is not reflected in any other surface water sample and is unlikely to be representative of the dissolved components in the surface water. The differences between the ratios of metals in the sediment at E3-P58-D01 and those in the surface water sample at this point means that the sediment within the dump may be variable over short distances. It is very unusual to filter surface water, but to obtain an accurate measure of dissolved metals in shallow swamps with highly contaminated sediment, would require that the samples be filtered to remove suspended solids. In surface water samples taken by OHM in 1992 south of Sudbury Road in the drainage to Boons Pond, the only compound found above background and screening levels was arsenic (up to 4.45 μg/L) in samples at P31SW3 and P31SW4. Arsenic was not found in the sample taken by OHM furthest downstream (P31SW5).

6.2.2.8 Conclusions and Recommendations

Sampling results indicate that the debris in Site P58 contributes to the contamination of soil, surface water, and sediments in the immediate wetland area surrounding the site northeast of Sudbury Road. The principle contaminant in groundwater is arsenic, which was found in filtered groundwater samples taken at the site. Principle contaminants in soil include metals such as copper, lead, manganese, and zinc, and low levels of several PAH compounds. The principle contaminants in surface water are metals from suspended sediment. The principle contaminants in sediment are the metals arsenic, cadmium, chromium, iron, lead, manganese, mercury, nickel, and zinc and a number of pesticides. TPHC is of lesser concern. Metal contaminants were not detected in levels above screening values in the sediment sample taken downstream of the culvert under Sudbury Road, indicating that metals

contamination may be limited to the wetland area northeast of Sudbury Road. PAHs were found in sediment samples at the site and downstream. Pesticides were also detected in sediments at levels above screening values, but rather than being site-related, these may be related to general pesticide spraying practices at the Annex and in the immediate off-site area. Concentrations of pesticides are not indicative of large-scale disposal, but of historic pest-management practices.

Since private wells are reportedly used by residents of Stow in the area around Boons Pond, the standards for drinking water are the appropriate benchmark for evaluating contaminant concentrations detected at Site P31 and Site P58. As mentioned above, arsenic was detected in filtered samples from well E3-P31-M01 at levels above drinking water standards. The presence of these contaminants in a potentially mobile form and the proximity of this site to Boons Pond warrants a supplemental site investigation at Sites P31 and P58. Sampling at off-site private wells downgradient of Sites P31/P58 should be conducted to identify any migration of contaminants from the site that may have occurred. Further soil and subsurface soil sampling should be conducted upgradient of well E3-P31-M01 to attempt to locate a source for the arsenic found in this well. Surface water and sediment sampling should be conducted with sampling upgradient of the debris area and downgradient along the runoff pathway to Boons Pond to further characterize the extent of contamination. Sampling should also be conducted at Boons Pond in the immediate area around the discharge of runoff from the site to determine whether any contaminants are migrating into Boons Pond from this site to the pond. Finally, surface soil sampling should be conducted in a four point grid around the OHM drum confirmation sample, P31CD1, to determine the extent of lead contamination.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 6-15
Chemical Summary Report For Groundwater
Site: P31
Units: UGL

Test	Site ID	E3-P31-M01	E3-P31-M01	E3-P31-M01	E3-P31-M01	E3-P31-M01	E3-P31-M01
	Field Sample ID	MDP31012	MFP31011	MFP31012	MHP31012	MXP31011	MXP31012
	Sample Date	12/03/93	09/01/93	12/03/93	12/03/93	09/01/93	12/03/93
Test	Parameter .						
EXPLOSIVES	PETN	< 10.0				6.59 J	< 10.0
TAL METAL	Aluminum	4080 J@	22.8 BJ	13.9 BJ	< 25.0	11000 J@	5910 J@
	Antimony	< 5.00	< 5.00	< 5.00	3.46 BJ	< 5.00	1.44 J
	Arsenic	62.3 @	66.0 @	63.4 @	70.3 @	91.2 @	74.2 J@
	Barium	26.7 J	17.5	16.6	13.2	54.6	32.7 J
	Beryllium	0.150 J	< 5.00	< 5.00	< 5.00	0.412 BJ	0.244 J
	Calcium	3800	4520	4440	4410	5370	4030
	Chromium	5.16 J	< 10.0	< 10.0	< 10.0	19.1	8.55 J
	Cobalt	16.5	18.0	19.3	16.2	24.4	17.5
	Copper	8.64 J	< 10.0	< 10.0	3.40 J	13.7	9.26 J
	Iron	18000 J@	20000 @	24000 @	21000 @	30000 @	22000 J@
	Lead	8.38	< 5.00	< 5.00	1.01 J	9.65	9.17
	Magnesium	1830 J	1400	1290	1310	3550	2280 J
	Manganese	630 @	891 @	734 @	716 @	995 @	664 @
	Nickel	11.9 J	< 10.0	< 10.0	< 10.0	20.4	13.0 J
	Potassium	2100	2390	1620	1760	3870	2380
	Selenium	< 2.00	< 2.00	3.30	< 2.00	< 2.00	< 2.00
	Sodium	5570 K	4290	4380 B	4390 B	5200	5660 K
	Vanadium	8.95 J	4.15 J	4.61 J	3.48 J	16.1	11.6 J
	Zinc	42.8 J	45.2 B	8.29 BJ	8.36 BJ	160	45.3 J
TCL VOA	134DMB	< 10.0				3.60 J	< 10.0
	Toluene	< 5.00				4.40 J	< 5.00

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. # = Exceeds ecological screening value
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. @= Exceeds human health screening value. != Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 6-16
Chemical Summary Report For Groundwater
Site: P58
Units: UGL

Test	Site ID	E3-P58-M01	E3-P58-M01	E3-P58-M01	E3-P58-M01	E3-P58-M01	E3-P58-M01
	Field Sample ID	MDP58011	MDP58012	MFP58011	MFP58012	MHP58011	MHP58012
	Sample Date	09/02/93	12/02/93	09/02/93	12/02/93	09/02/93	12/02/93
Test	Parameter .						
TAL METAL	Aluminum	22000 J@	29000 J@	69.8 B@	54.4 B@	70.7 B@	83.3 B@
	Arsenic	46.3	47.0 J	2.21	< 2.00	2.84	< 2.00
	Barium	219	419 J	108	247	118	262
	Beryllium	1.26 J	1.64 J	< 5.00	< 5.00	< 5.00	< 5.00
	Cadmium	2.54 J	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
	Calcium	6640	8910	5800	6980	5720	6810
	Chromium	25.9	32.8	7.80 J	< 10.0	< 10.0	< 10.0
	Cobalt	17.9	24.1	3.84 J	3.62 J	4.04 J	3.42
	Copper	39.0	55.3	3.84 J	< 10.0	< 10.0	< 10.0
	Iron	33000 K@	53000 J@	9640 K@	14000 @	9960 K@	13000 @
	Lead	30.5 @	43.4 @	< 5.00	< 5.00	< 5.00	< 5.00
	Magnesium	4020	5280 J	1000	1050	968	998
	Manganese	942 @	791 @	737 @	578 @	739 @	561 @
	Nickel	27.2	37.9 J	< 10.0	< 10.0	< 10.0	8.32
	Potassium	2220	3840 B	740 J	939 J	700 J	861
	Sodium	4470	8610 K	4050	5720 K	3930	6430 K
	Vanadium	30.9	40.5 J	< 10.0	3.63 J	< 10.0	4.89
	Zinc	141	532 J	23.2 B	190	19.1 BJ	220
TCL Pest	P,P-DDE	0.028 JC	< 0.048				
	beta-BHC	0.050 C	< 0.024				
	delta-BHC	< 0.020	< 0.024				
WQP	Nitrate		68.7 J				
	Phosphorus, Total		1200 J				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 6-16
Chemical Summary Report For Groundwater
Site: P58
Units: UGL

	Site ID	E3-P58-M01	E3-P58-M01	E3-P58-M02	E3-P58-M02	E3-P58-M02	E3-P58-M02
	Field Sample ID	MXP58011	MXP58012	MFP58021	MFP58022	MXP58021	MXP58022
	Sample Date	09/02/93	12/02/93	09/02/93	12/02/93	09/02/93	12/02/93
Test	Parameter .						
TAL METAL	Aluminum	15000 J@	4320 J@	24.1 BJ	16.7 BJ	342 J@	197 J@
	Arsenic	37.1	6.52 J	11.6	5.06	16.6	12.2 J
	Barium	199	300 J	8.24 J	7.64 J	12.3	9.57 J
	Beryllium	0.980 J	0.252 J	< 5.00	< 5.00	< 5.00	< 5.00
	Cadmium	< 5.00	1.42 J	< 5.00	< 5.00	< 5.00	< 5.00
	Calcium	6450	7490	4250	2800	4390	2840
	Chromium	18.8	6.24 J	< 10.0	< 10.0	2.81 J	< 10.0
	Cobalt	16.3	7.65 J	20.8	11.0	24.7	14.5
	Copper	31.0	14.4	< 10.0	< 10.0	< 10.0	12.3
	Iron	26000 K@	20000 J@	5560 K@	2740 @	7750 K@	6350 J@
	Lead	23.0 @	4.96 KJ	< 5.00	< 5.00	1.04 J	1.41 BJ
	Magnesium	3260	1860 J	904	768	940	815 J
	Manganese	864 @	634 @	1000 @	535 @	1100 @	612 @
	Nickel	20.8	11.4 J	< 10.0	< 10.0	< 10.0	< 10.0 J
	Potassium	1930	2060 B	15800	6380	16800	5640 K
	Sodium	4310	7640 K	7940	4710 B	8240	5620 B
	Vanadium	25.0	9.36 J	< 10.0	< 10.0	< 10.0	< 10.0 J
	Zinc	128	389 J	97.7 B	90.8	138	122 J
TCL Pest	P,P-DDE	< 0.200	< 0.049			< 0.800	< 0.160
	beta-BHC	< 0.100	< 0.025			< 0.400	< 0.080
	delta-BHC	< 0.100	< 0.025			0.600	0.086 U
WQP	Nitrate		45.3 J				29.8 J
	Phosphorus, Total		36.0 J				25.0 J

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value. K= Result bias high.
L= Result bias low. R= Result rejected.

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@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 6-17
Chemical Summary Report For Subsurface Soils
Site: P31
Units: UGG

	Site ID	E3-P31-B01	E3-P31-B01	E3-P31-B01	E3-P31-B02	E3-P31-B02	E3-P31-B03
	Field Sample ID	EDP31012	EXP31011	EXP31012	EXP31021	EXP31022	EXP31031
	Sample Date	09/24/93	09/24/93	09/24/93	09/24/93	09/24/93	09/24/93
Test	Parameter Depth	4.5 ft.	1.5 ft.	4.5 ft.	1.5 ft.	4.5 ft.	1.5 ft.
TAL METAL	Aluminum	2860 J	6370 J	5170 J	6410 J	5710 J	9290 J
	Antimony	0.257 J	0.299 J	< 0.500	< 0.500	< 0.500	< 0.500
	Arsenic	6.46	6.04	6.87	5.84	6.00	4.12
	Barium	8.87	15.8	13.9	12.7	10.0	8.91
	Beryllium	0.190 JL	0.283 JL	0.267 JL	0.256 JL	0.252 JL	0.440 JL@
	Cadmium	< 0.500	0.155 J	< 0.500	< 0.500	< 0.500	< 0.500
	Calcium	176 J	96.7 J	171 J	< 500	< 500	99.2 J
	Chromium	3.73	8.38	7.83	5.64	6.56	6.04
	Cobalt	2.99	4.07	4.57	5.71	2.93	2.59
	Copper	3.74	4.58	6.03	2.96	4.03	3.43
	Iron	2980 J	6090 J	5530 J	5260 J	5960 J	4550 J
	Magnesium	468 J	952	992	322 J	615	235 J
	Manganese	82.9	93.1	129 !	121 !	33.1	26.7
	Nickel	3.38	6.50	7.52	4.02	4.72	4.59
	Potassium	321 K	423 K	417 K	145 BJ	265 B	203 BJ
	Sodium	< 200	< 200	< 200	< 200	< 200	243 KJ
	Vanadium	5.19	10.3	9.05	8.76	9.50	8.41
	Zinc	13.4 K	24.6 K	19.4 K	17.7 K	21.1 K	13.8 K
TCL Pest	Endosulfan Sulfate	0.003 C	0.001 JC	0.003 C	0.005 U	0.003 U	0.006 C
	Endrin Aldehyde	0.004 BC	0.003 BU	0.007 BC	0.009 BC	0.001 BJC	0.015 KC!
	P,P-DDT	0.006 U	0.002 C	0.007 C	0.017 C	0.006 C	0.008 U
	beta-BHC	0.001 JC	< 0.002	0.001 JC	0.001 JC	< 0.002	< 0.002
TOC	Total Organic Carbon						
TPHC	Total Petroleum Hydrocarbons	< 20.0	< 20.0	11.4 J	< 20.0	11.0 J	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

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@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 6-17
Chemical Summary Report For Subsurface Soils
Site: P31
Units: UGG

	Site ID	E3-P31-M01					
	Field Sample ID	BX3101X1					
	Sample Date	08/12/93					
Test	Parameter Depth	9.0 ft.					
TAL METAL	Aluminum						
	Antimony						
	Arsenic						
	Barium						
	Beryllium						
	Cadmium						
	Calcium						
	Chromium						
	Cobalt						
	Copper						
	Iron						
	Magnesium						
	Manganese						
	Nickel						
	Potassium						
	Sodium						
	Vanadium						
	Zinc						
TCL Pest	Endosulfan Sulfate						
	Endrin Aldehyde						
	P,P-DDT						
	beta-BHC						
TOC	Total Organic Carbon	5310					
TPHC	Total Petroleum Hydrocarbons						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 6-18
Chemical Summary Report For Subsurface Soils
Site: P58
Units: UGG

	Site ID	E3-P58-M01	E3-P58-M02				
	Field Sample ID	BX5801X1	BX5802X1				
	Sample Date	08/12/93	08/12/93				
Test	Parameter Depth	44.0 ft.	9.0 ft.				
TOC	Total Organic Carbon	2010	14800				

Source: USAEC IRDMIS Level 3/E & E, 1994

Table: 6-19
Chemical Summary Report For Surficial Soils
Site: P58
Units: UGG

	Site ID	E3-P58-S01	E3-P58-S02	E3-P58-S03	E3-P58-S04		
	Field Sample ID	SXP58011	SXP58021	SXP58031	SXP58041		
	Sample Date	09/20/93	09/20/93	09/20/93	09/20/93		
Test	Parameter						
TAL METAL	Aluminum	6720	6280	6250	7780		
	Antimony	2.99 !	1.77 !	2.76 !	9.53 !		
	Arsenic	16.0 !	5.40	12.3 !	7.20		
	Barium	450 !	44.7 !	940 !	69.6 !		
	Beryllium	0.292 JL	0.259 JL	0.266 JL	0.428 JL@		
	Cadmium	6.12 !	0.932 B!	0.926 B!	1.21 B!		
	Calcium	2530 !	338 J	3030 !	1020		
	Chromium	23.0 !	11.2	78.7 !	16.2 !		
	Cobalt	12.8 !	5.49	25.3 !	7.38 !		
	Copper	660 L!	12.9 L!	4300 L!@	300 L!		
	Iron	32000 !	12000	82000 !	14000 !		
	Lead	1300 !@	120	990 !@	480 !@		
	Magnesium	131000 !	150000 !	85700 !	195 J		
	Manganese	792 !@	126 !	1010 !@	146 !		
	Mercury	1.68 !	< 0.100	0.231	0.262		
	Nickel	22.3 !	11.1 !	39.4 !	14.3 !		
	Potassium	318 K	266 B	272 BJ	235 BJ		
	Selenium	0.425	0.228 J	0.303	0.616 !		
	Thallium	0.109 J	0.105 J	0.174 J	< 0.500		
	Vanadium	20.3	12.4	19.1	21.2		
	Zinc	2800 J!@	86.2 J!	1600 J!	200 J!		
TCL BNA	Benzo(a)anthracene	1.60 @	< 0.660	< 0.660	< 0.660		
	Benzo(a)pyrene	1.30 @	< 0.660	< 0.660	< 0.660		
	Benzo(b)fluoranthene	1.50 @	< 0.660	< 0.660	0.870 @		
	Bis(2-ethylhexyl)phthalate	2.10	< 0.660	< 0.660	< 0.660		
	Chrysene	1.50 @	< 0.660	< 0.660	< 0.660		
	Fluoranthene	2.60	< 0.660	< 0.660	0.920		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table: 6-19
Chemical Summary Report For Surficial Soils
Site: P58
Units: UGG

	Site ID	E3-P58-S01	E3-P58-S02	E3-P58-S03	E3-P58-S04		
	Field Sample ID	SXP58011	SXP58021	SXP58031	SXP58041		
	Sample Date	09/20/93	09/20/93	09/20/93	09/20/93		
Test	Parameter .						
TCL BNA	Pyrene	2.90	< 0.660	< 0.660	1.00		
TCL Pest	Dieldrin	0.014 KU	0.002 BJU	0.006 BU	0.013 KC		
	Endosulfan,A	0.002 JU	0.001 JC	< 0.002	0.001 JC		
	P,P-DDD	0.020 C	0.008 U	0.006 U	0.034 C		
	P,P-DDE	0.086 C	0.035 C	0.026 KC	0.039 C		
	P,P-DDT	0.099 C	0.034 C	0.054 C	0.109 C		
	delta-BHC	0.001 JC	0.002 JC	< 0.002	< 0.002		
TOC	Total Organic Carbon	46400					
TPHC	Total Petroleum Hydrocarbons	26.8 J	12.8 J	25.4 J	58.9		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSW
Site Type: POND

Table: 6-20
Chemical Summary Report For Surface Waters
Site: P58
Units: UGL

	Site ID	E3-P58-D01					
	Field Sample ID	WXP58012					
	Sample Date	12/02/93					
Test	Parameter .						
ANI2	Orthophosphate	57.0 J					
TAL METAL	Aluminum	18000 !					
	Antimony	7.17 !					
	Arsenic	38.5 !@					
	Barium	7500 !					
	Beryllium	2.79 J					
	Cadmium	90.1 J!#					
	Calcium	21000 !					
	Chromium	1500 !					
	Cobalt	530 J!					
	Copper	6300 !#					
	Iron	6900000 !#					
	Lead	7300 !#					
	Magnesium	516					
	Manganese	5400 !					
	Mercury	5.52 J@#					
	Nickel	939 !@#					
	Potassium	8360 K!					
	Vanadium	163 !					
	Zinc	31000 !#					
TCL BNA	Diethyl phthalate	23.0					
TPHC	Total Petroleum Hydrocarbons	179 J					
WQP	Phosphorus, Total	3600 J!					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination. J= Estimated value. L= Result bias low. # = Exceeds ecological screening value
C= Confirmed on second column, U= Unconfirmed. K= Result bias high. R= Result rejected. @= Exceeds human health screening value. != Exceeds Background.

Date: 03/17/94
File Type: CSE
Site Type: POND

Table: 6-21
Chemical Summary Report For Sediments
Site: P58
Units: UGG

Test	Parameter	E3-P58-D01	E3-P58-D02				
	Field Sample ID	DXP58011	DXP58021				
	Sample Date	09/16/93	09/16/93				
EXPLOSIVES	4-Amino-2,6-dinitrotoluene	< 1.00	< 1.00				
TAL METAL	Aluminum	873 J	4930				
	Antimony	6.04 !#	0.394 BJ				
	Arsenic	15.3 !#	2.43 !				
	Barium	354 !	22.6				
	Beryllium	< 0.500 L	0.241 JL!				
	Cadmium	28.8 !#	0.448 BJ				
	Calcium	948 J!	224 J				
	Chromium	131 !#	9.05				
	Cobalt	59.7 !#	4.53 !				
	Copper	600 L!#	9.19 L!				
	Iron	280000 !#	10000 !				
	Lead	950 !@#	31.0 !				
	Magnesium	< 50000	175000 !				
	Manganese	963 !@#	77.8 !				
	Mercury	0.765 #	< 0.100				
	Nickel	109 !#	10.4 !				
	Potassium	< 20000	452 K				
	Thallium	< 0.500	0.095 J				
	Vanadium	24.3 !	11.6				
	Zinc	3600 J!@#	38.6 J!				
TCL BNA	1MBAAN		0.160				
	2-Methylnaphthalene	< 0.330	0.160 J#				
	25DMPA		0.160				
	27DNAP		0.140				
	Acenaphthylene	< 0.330	0.200 J				
	Anthracene	< 0.330	0.140 J#				

Note: the first header row of the table reads "Site ID" in the Parameter column.

Source: USAEC IRDMIS Level 3/E & E; 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table: 6-21
Chemical Summary Report For Sediments
Site: P58
Units: UGG

	Site ID	E3-P58-D01	E3-P58-D02				
	Field Sample ID	DXP58011	DXP58021				
	Sample Date	09/16/93	09/16/93				
Test	Parameter .						
TCL BNA	Benzo(a)anthracene	< 0.330	0.660 #				
	Benzo(a)pyrene	2.00 @#	0.640 #				
	Benzo(b)fluoranthene	< 0.330	0.960 @				
	Benzo(ghi)perylene	< 0.330	0.460				
	Chrysene	1.30 @#	1.10 @#				
	Dibenzo(a,h)anthracene	< 0.330	0.160 J				
	Dibenzofuran	< 0.330	0.052 J				
	Fluoranthene	0.220 J	1.20 #				
	Fluorene	< 0.330	0.180 J				
	Indeno(1,2,3-cd)pyrene	< 0.330	0.470				
	Naphthalene	0.200 J	0.091 J				
	Phenanthrene	0.190 J	1.70 #				
	Pyrene	0.280 J	1.80 #				
TCL Pest	Aldrin	0.004 KJC#	0.001 BJC				
	Dieldrin	0.010 C!#	0.038 C!@#				
	Endosulfan,A	0.004 JC!	0.005 C!				
	Heptachlor Epoxide	0.002 JC!	0.016 C!#				
	P,P-DDD	0.215 U#	0.019 C#				
	P,P-DDE	0.041 C#	0.015 C#				
	P,P-DDT	0.012 C#	0.037 C#				
	gamma-Chlordane	0.002 JU#	0.003 C#				
TOC	Total Organic Carbon	394000	39400				
TPHC	Total Petroleum Hydrocarbons	1800 !@#	129 !#				

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

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C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

6.2.3 Site P40 — Building T452

Site P40, shown on the site map in Figure 6-4, was identified by OHM in 1992 pursuant to the discovery of PCE in a nearby well (installed for the investigation on Site A5), which may have originated from a cesspool located behind Building T452 (OHM 1992). Site P40 was also the site of a fuel oil spill from a UST in 1992.

6.2.3.1 Site Location

Building T452 is in the central part of the Annex on the northwest corner of the southern intersection of Patrol Road and White Pond Road and faces Patrol Road. On the eastern side of the building, there are cellar doors and a fuel oil fill spout. A drum filled with salt stands between the building and the road. There is a large, square-shaped clear area around the building. An underground cesspool is buried about 60 feet east of Building T452.

6.2.3.2 Physical Characteristics

Site P40 lies on an area of glacial outwash approximately 205 feet AMSL. The groundwater elevation across the site is approximately 194 feet AMSL. Two shallow monitoring wells (OHM-P46-38 and OHM-P40-39), installed by OHM in 1992, disclose a poorly graded sand and gravel layer with some silt extending to a depth of at least 20 feet BGS. Monitoring well E3-A5-M01 serves as a downgradient well for Site A5, but is actually within Site P40 boundaries. Drilling logs from this well show a poorly graded sand and gravel layer from 0 to 15 feet BGS, and a grey silt with clay and fine sand of glaciolacustrine origin extending from 15 feet to 51 feet BGS, the maximum depth achieved at this location. Bedrock was encountered at well OHM-P40-29 at 62 feet BGS; however, because a mud rotary drill was used, a detailed soil classification log could not be generated and bedrock type was not identified.

An average transmissivity of 2,000 feet^2 per day was calculated by OHM for the three monitoring wells OHM-P40-29, OHM-P40-38, and OHM-P40-39. This number was calculated based on an average conductivity and the presumption of a uniform aquifer thickness across the site of 50 feet. This thickness is approximately equal to the length of the water column within the overburden.

Monitoring well E3-A5-M01, located within the Site P40 boundary, had a calculated transmissivity of 24.36 feet^2 per day. This is not comparable to the OHM calculated average value for several reasons. First, well E3-A5-M01 was installed within the dense glaciolacustrine gray silt layer, while two of the OHM wells were installed in the overlying outwash and the third OHM well was set into bedrock. These are not comparable strata. Second, OHM presumed a uniform aquifer thickness of 50 feet, while a 39 foot aquifer thickness was presumed to calculate transmissivity at well E3-A5-M01. Finally, OHM's presumed uniform aquifer thickness of 50 feet does not account for the varying conductivities of the different strata. It seems logical to conclude that Site P40 has a layer of outwash

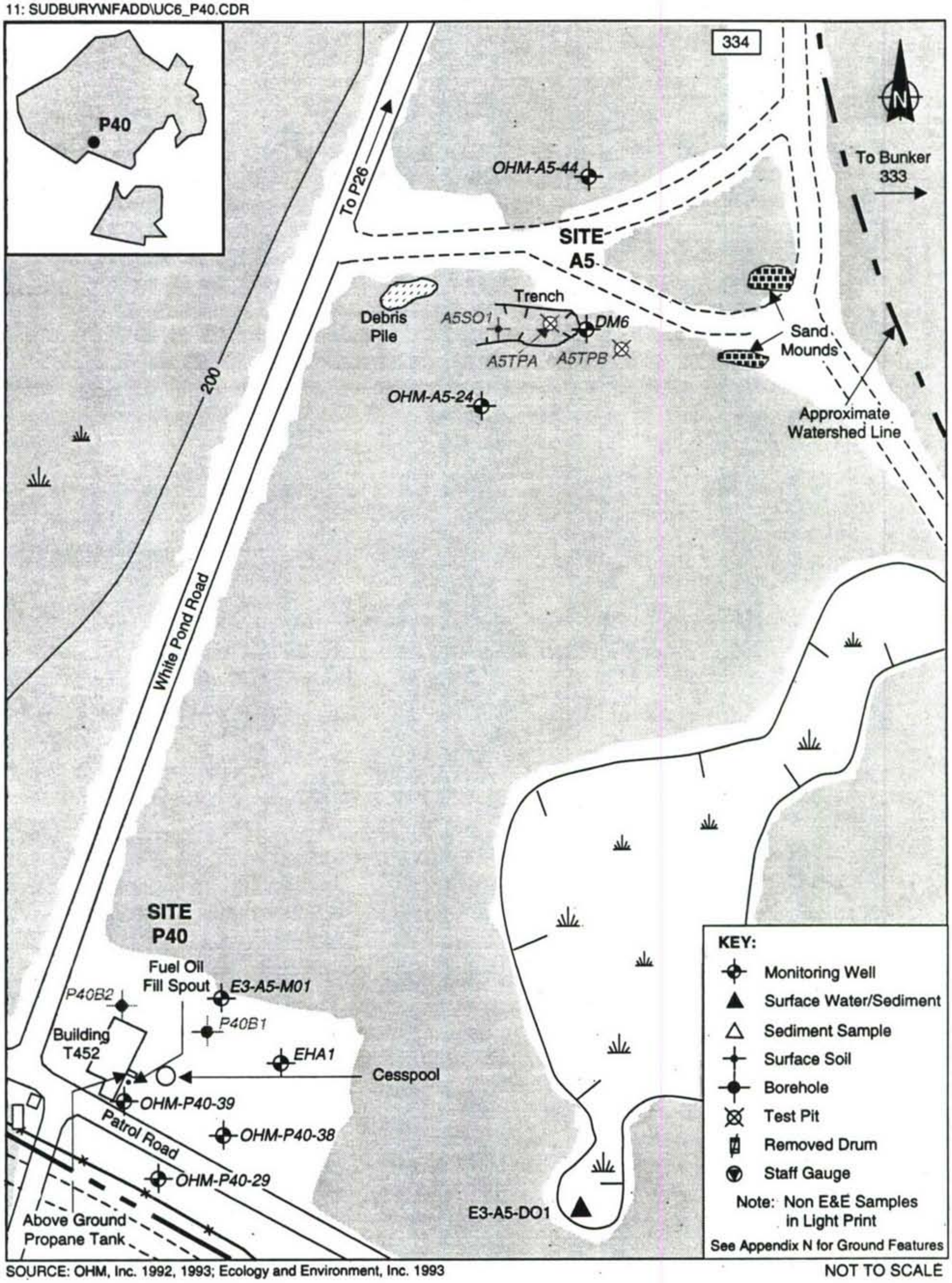


Figure 6-4 MAP OF SITE P40 BUILDING T452 TEST AREA

material from 15 to 20 feet thick, and moderate transmissivity, underlain by a less transmissive silty layer of approximately 40 feet thick, or more. Bedrock is approximately 60 feet BGS. Water table elevations show a flat water table at Site P40 with a hydraulic gradient of 0.01 ft/ft and a direction approximately south-southeast. Neither of which changed significantly between 13 September 1993 and 3 December 1993. The gradient swings around to south closer to Boons Pond but remains at approximately 0.01 ft/ft between OHM-P40-29 and OHM-P40-39 are placed downgradient of the fuel oil spill and the cesspool.

Surface water at Site P40 apparently drains east to an adjacent wetland which is in a closed depression. Based on water level information, groundwater flow is southwest toward Boons Pond.

6.2.3.3 Ecological Characterization

Site P40 is in the central part of the annex at the southern intersection of Patrol Road and White Pond Road. The vegetation surrounding Building T452 is grasses and low-growing forbs. Surrounding this open area is a dense, white pine forest with tree height ranging from 40 to 61 feet.

Due to the topography of the area, surface water runoff from Site P40 will most likely flow to the east into a broad-leaved, deciduous, scrub-shrub wetland adjacent to the site. Associated with this wetland is approximately 2 acre vernal pool dominated by sphagnum moss sedge (Butler 1992).

The wildlife value for this area is considered to be moderate. White pines provide suitable nesting and roosting habitat for many songbirds and upland game birds and cover for numerous mammal species. Many wildlife species will consume the needles, buds, seeds, and bark of the white pine year-round. The cleared area also provides nesting and roosting areas for songbirds and upland game birds and a variety of seeds, fruits, and various other herbaceous materials for wildlife consumption. The scrub-shrub wetland provides nesting and roosting areas for migratory waterfowl and songbirds. Also, many of the buds, seeds, catkins, twigs, and leaves produced by the shrubs and herbaceous material occurring within the wetland are consumed by a variety of wildlife. The vernal pool associated with this wetland is utilized for breeding by wood frogs and spring peepers (Butler 1992).

No unique habitats have been identified in the general vicinity of Site P40 (NHESP 1992). However, a stand of red pine, a state watch-list species, has been found approximately 3,000 feet southeast of Site P40 (Hunt 1992). In addition, the scrub-shrub wetland includes a dwarf shrub bog that is considered to be a very unusual habitat type in this area (Hunt 1992). This type of wetland provides suitable habitat for four-toed salamanders (*Henidactylium scutatum*), which are given "special concern" status by the Massachusetts Department of Fish and Wildlife. Further to the southeast of the site, an additional dwarf shrub bog has been identified; this wetland supports a population of few-fruited sedge (*Carex oligosperma*), a state threatened species.

6.2.3.4 Site History

Site P40 consists of Building T452 and the immediately surrounding area. Building T452 was originally built in 1952 as a bungalow. Starting in 1958, the building was adapted for use as an interim facility for animal testing. Correspondence from 1959 notes that construction was being carried out on a refurbished cottage and included the installation of two 50 foot refrigerator boxes. These facilities were originally intended to be used as the center of the Natick Environmental Protection Research and Development Division activities at MAYTAC. The focus of research carried out by this division (not necessarily at Site P40 or at the Annex) included research on the effects of extreme climatic conditions; the effects of severe work and fatigue; the effects of restricted water and nutrition; the psychological effects of stress; the thermal (heat) effects of nuclear weapons; the protective effect of clothing and personal equipment; and the effect of stress on organs, tissues, and cells. One of the refrigerator boxes was to be used as a simple climate chamber for human testing. The other was to be used as a climate chamber for animal testing. These facilities at Building T452 were apparently used from 1959 until sometime in the early 1960s on an interim basis, pending the construction of a complete animal laboratory. A memorandum from late 1959 stated that interim facilities for animals at MAYTAC encompassed 2,240 square feet (Building T452 has a floor space of 1,920 square feet, so the larger figure probably included a small portion of the surrounding area, perhaps outdoor animal pens). In 1961, the decision was made by Natick Command to construct the animal laboratory facility at Natick. In 1962, this facility was redesignated the "Subsistence Evaluation Laboratory." Construction on the laboratory was carried out in 1964 at Natick.

Building T452 has also been used by meteorological teams. A 1960 photograph shows the building as being used by the Signal Meteorology Team (SigMet). Natick Real Property records include a memorandum from the facility engineer that noted that Building T452 was converted into a laboratory in 1961. However, on a 1962 map, the building was unassigned, and a 1964 map of the facility only noted Building T452 as a "future laboratory." Other property records indicate that Building T452 was designated as a meteorology station from 1966 to 1971.

In 1971, Building T452 was converted back into a bungalow for use as guest quarters. In April 1992, an oil spill occurred at Site P40 near the fill port for a 275 gallon fuel oil tank located in the basement of Building T452 due to overfilling. Subsequent inspection revealed a large stain in the soil by the fill port and fuel oil in the basement and in the dry well located in the basement. Natick Laboratories' contractor A-1 Environmental Services pumped out 15 gallons of oil and over 300 gallons of water from the dry well, which was later manifested out as recyclable material. The stain was noted as possibly being related to spills prior to the most recent one. A contractor performed a removal of the contaminated soil (OHM 1994). The details of this removal are described in the next section.

6.2.3.5 Results of Previous Investigations

A detailed description of the work performed at Site P40 is included in Section 7.49 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994).

In 1983, AEHA installed and sampled monitoring well EHA-1. The sample was analyzed for constituents on the Primary Drinking Water Standards List and for organic priority pollutants. PCE (22 μg/L), nitrogen (0.13 μg/L), as nitrate or nitrite, and fluoride (1,000 μg/L) were detected. No other parameters were detected. EHA1 was resampled by Dames and Moore in 1984 as part of its investigation of Site A5, and PCE (30 μg/L) was detected. This result was not considered related to Site A5. The potential source of the PCE was hypothesized to be the cesspool behind Building T452. Well EHA1 was resampled by Fort Devens in 1986 and 1988 and no PCE was found at the detection limits of 4 μg/L from the 1986 analysis and 2 μg/L from the 1988 analysis.

Dames and Moore collected one surface water and one sediment sample from a stream 700 feet northwest of the area along Patrol Road in 1984. The sample was tested for VOCs only and showed an elevated level of unknown VOCs believed to have been introduced either by passing traffic on Patrol Road or by laboratory contamination.

In August 1992, Laidlaw Environmental Services collected a composite soil sample from the excavation of the soil contaminated as a result of overfilling of the heating oil tank in Building T452. The soil sample contained TPHC (772 μg/g). Laidlaw excavated and removed a total of ten cubic yards of contaminated soil. The excavation pit was free of petroleum odor and stains. Analysis of a soil sample taken after this excavation indicated low levels of TPHC (65 μg/g). The excavation was then backfilled. Laidlaw also drilled two 3 foot deep soil borings through the concrete basement floor in Building T452, and sampled subsurface soil. TPHC was not detected in either sample at a method detection limit (MDL) of 40 μg/g. A liquid sample from the dry well was collected by Laidlaw and analysis showed 7.9 mg/L TPHC.

OHM performed an SI in 1992, which included a geophysical study, soil borings with subsurface soil sampling, and monitoring well installation with subsurface soil and groundwater monitoring. All samples were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticide/PCBs, TAL metals, and explosives.

The SM geophysical study was performed to determine appropriate locations for boreholes. Subsurface samples were collected at borehole locations. Only cobalt, magnesium, and potassium were detected in subsurface soils above background levels, but they probably represent natural variation.

Three additional shallow monitoring wells were installed by OHM. Groundwater sampling showed PCE (2.7 μg/L) in groundwater from well EHA1 in June 1992 and PCE (2.6 μg/L) in October 1992. PCE was not detected in the other site wells.

Acetone (12 μg/L) was noted in OHM-P40-29 in June but not in October 1992. Several metals were noted in the shallow wells, but none appeared to be significantly elevated. Metals in the bedrock well (OHM-P40-29) were higher than in the shallow wells: specifically, arsenic in June (12.5 μg/L) and October (13 μg/L) 1992; calcium, iron, magnesium, manganese, potassium, and sodium were detected, but these levels may represent natural groundwater quality.

6.2.3.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigations at Site P40, Building T452, and its surrounding area were analyzed for TCL organics and TAL metals. The Phase II Sampling Effort for Site P40 is summarized in Table 6-22.

Table 6-22

PHASE II FIELD EFFORTS AT SITE P40 (BUILDING T452)

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	4	08/30/93	The four downgradient monitoring wells were sampled to investigate the potential for contaminant migration through the groundwater pathway.
Water	1	09/15/93	Sample was collected to characterize the contents of the underground cesspool.

Source: Ecology and Environment, Inc. 1994.

Geophysical Investigations

An EM-31 reconnaissance survey was conducted at Site P40 to search for the locations of a suspected cistern and septic tank. The survey was also used to investigate the presence of any other buried debris in the area surrounding Building T452. Other than the cesspool that was located east of Building T452, no other subsurface tanks were identified at the site during the geophysical survey.

Groundwater Sampling

To characterize groundwater quality at Site P40, E & E sampled four monitoring wells: EHA1, OHM-P40-29, OHM-P40-38, and OHM-P40-39 were all sampled during the August 1993 round of groundwater sampling. In addition, one water sample was collected in September 1993 from the cesspool located east of Building T452 to characterize the contents of the tank. The sample provides data to assess whether the cesspool is a potential contaminant source.

6.2.3.7 Nature and Extent of Contamination

Analysis of groundwater samples from the first round of sampling in August 1993 from the four monitoring wells at Site P40 did not detect any pattern of site-related contamination. Levels of aluminum, iron, and manganese found in unfiltered samples were elevated above MA SMCL levels for aesthetics and taste, but are probably due to the presence of suspended solids in the groundwater. The sodium level (21,500 μg/L) detected in the bedrock well OHM-P40-29 was elevated relative to the sodium levels in the three shallow wells (EHA1, OHM-P40-38, and OHM-P40-39), which may reflect sodium levels in the

bedrock that are not present in as high a concentration as in the overburden layer. This sodium level slightly exceeds the EPA Drinking Water Health Advisory level of 20,000 μg/L, but is below the Massachusetts MCL of 28,000 μg/L. A summary of detections above preliminary screening levels is provided in Table 6-23. In addition, a summary of analytical results is provided at the end of this discussion in Table 6-24.

Table 6-23

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P40

Medium (Units)	Compound	Maximum Back-ground	Screen Level	Source	Maximum Concen-tration	Site ID	Frequency Above Screen Level
GW (μg/L)	Aluminum (U)[1]	--	50	MA SMCL[2]	19,000	OHM-P40-38	4/4
	Iron (U)	--	300	MA SMCL	16,000	OHM-P40-38	4/4
	Manganese (U)	--	50	MA SMCL	3,400	OHM-P40-29	4/4
	Sodium (U)	--	20,000	EPA Health Advisories	21,500	OHM-P40-29	1/4
GW (In cesspool, μg/L)	Aluminum (U)	--	50	MA SMCL	2,890	E3-P40-T01	1/1
	Cadmium (U)	--	5	SDWA MCL[3]	5.76	E3-P40-T01	1/1
	Iron (U)	--	300	MA SMCL	39,000	E3-P40-T01	1/1
	Lead (U)	--	15	MA MCL[4]	93.7	E3-P40-T01	1/1
	Manganese (U)	--	50	MA SMCL	258	E3-P40-T01	1/1

[1]U = Unfiltered groundwater sample.
[2]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[3]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
[4]MA MCL = Massachusetts Maximum Contaminant Level.

Source: Ecology and Environment, Inc. 1994.

The pesticide δ-benzenehexachloride (0.560 μg/L and 0.037 μg/L), was found at low levels in OHM-P40-29 and OHM-P40-39, respectively, but not in the other two monitoring wells. No screening value could be found for this compound. The only other organic compound found in groundwater was bis(2-ethylhexyl)phthalate (3.90 μg/L) in well OHM-P40-29. This level is below the SDWA MCL, Massachusetts MCL, and MCP GW-1 value of 6 μg/L. No solvents were found in any of the groundwater samples taken at the site.

Analysis of the water sample taken from the cesspool located east of Building T452 indicated elevated levels of cadmium (5.76 μg/L) and lead (93.7 μg/L) in addition to elevated levels of aluminum, iron, and manganese. The cadmium level is above the SDWA MCL of 5 μg/L for cadmium and the lead level is above the Massachusetts MCL and MCP GW-1 level of 15 μg/L, and the MCP GW-3 level of 30 μg/L. The source of these metals may be the cesspool container itself or the piping that feeds the cesspool. The lead level may be the result of lead solder commonly used in the past in piping systems. The source of the cadmium is unknown.

6.2.3.8 Conclusions and Recommendations

The initial concern at this site was that a source potentially related to Building T452 may have been the cause of elevated levels of PCE found in well EHA1 in 1983 and 1984, and again in 1992. Recent groundwater sampling does not support the hypothesis of any solvent contamination around Site P40. The cesspool was sampled to determine whether PCE could have been discharged from Building T452 into the cesspool, and then leaked into groundwater. The results from the cesspool water sample do not indicate any organic contamination. The more probable source of the PCE detected at well EHA1 in earlier sampling rounds is limited solvent dumping that may have occurred at Site A5.

Elevated levels of cadmium and lead were found in the water from the cesspool at levels above drinking water standards, but were not detected at elevated levels in the monitoring wells downgradient of the cesspool (OHM-P40-39, OHM-P40-38, and OHM-P40-29). It is concluded that the metals may be from the plumbing system at Building T452.

A fuel oil spill occurred at this site in 1992 at the fillpipe immediately adjacent to Building T452. While groundwater samples at this site were not analyzed by E & E for TPHC, no organic constituents of fuel oil such as BTEX were detected in groundwater at the site. It appears that the spill has not had an impact on groundwater.

The initial concern of a solvent source at this site was not confirmed by subsequent sampling. There appears to be little impact from this site on groundwater supplies, and no further action is recommended at this site. However, some of the wells at this site may need to be resampled as part of continued monitoring at Site A5.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table: 6-24
Chemical Summary Report For Groundwater
Site: P40
Units: UGL

	Site ID	EHA1	OHM-P40-29	OHM-P40-38	OHM-P40-39		
	Field Sample ID	MXP40EH1	MXP40291	MXP40381	MXP40391		
	Sample Date	08/30/93	08/31/93	08/30/93	08/31/93		
Test	Parameter .						
TAL METAL	Aluminum	2540 J@	2330 J@	19000 J@	4200 J@		
	Arsenic	5.48	21.6	45.0	19.0		
	Barium	22.2	74.5	64.6	27.7		
	Beryllium	0.329 BJ	0.094 BJ	1.14 KJ	0.368 BJ		
	Calcium	2800	54600	3460	2050		
	Chromium	8.50 J	8.70 J	20.8	6.44 J		
	Cobalt	< 10.0	18.4	16.2	< 10.0		
	Copper	5.98 J	7.60 J	16.2	1.54 J		
	Iron	3140 @	3660 @	16000 @	3590 @		
	Lead	3.53 J	< 5.00	14.7	< 5.00		
	Magnesium	1240	8160	3250	1060		
	Manganese	161 @	3400 @	635 @	142 @		
	Nickel	10.8	25.3	27.7	11.0		
	Potassium	1320	15900	2280	1030		
	Sodium	4250	21500 @	7720	7100		
	Vanadium	< 10.0	2.98 J	19.4	< 10.0		
TCL BNA	Bis(2-ethylhexyl)phthalate	< 10.0	3.90 J	< 10.0	< 10.0		
TCL Pest	delta-BHC	< 0.022	0.560	< 0.100	0.037		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: SPTK

Table: 6-24
Chemical Summary Report For Groundwater
Site: P40
Units: UGL

	Site ID	E3-P40-T01					
	Field Sample ID	WXP40011					
	Sample Date	09/15/93					
Test	Parameter .						
TAL METAL	Aluminum	2890 @					
	Arsenic	14.5					
	Barium	71.3					
	Cadmium	5.76 @					
	Calcium	24500					
	Chromium	8.95 JK					
	Cobalt	11.6					
	Copper	498					
	Iron	39000 @					
	Lead	93.7 @					
	Magnesium	2610					
	Manganese	258 @					
	Mercury	0.701					
	Nickel	33.9					
	Potassium	7820					
	Sodium	7070					
	Vanadium	11.0					
	Zinc	776					
TCL BNA	Bis(2-ethylhexyl)phthalate	4.30 J					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

7. WATERSHED 6 — WILLIS POND AND CRYSTAL LAKE

7.1 WATERSHED DESCRIPTION AND ASSESSMENT

Proposed investigative activities for the sites identified at the Annex were determined through a review of previous activities and findings and were governed by the established SOW. The objectives of the activities were to determine whether contamination is present in groundwater, surface water, sediment, or surface/subsurface soils at the assigned Phase II sites, and, in the cases where contamination is thought or known to exist, to confirm and better characterize its nature and extent.

To evaluate each site, and to develop a better understanding of the site's impact on the Annex environment, the Annex was divided into seven distinct watersheds. The general findings of the field effort are summarized for the individual watersheds. Detailed information about activities undertaken and sampling results for each site are then provided. Site results, conclusions, and recommendations are reviewed and discussed in conjunction with the results of the OHM Phase I investigation. The chemical results are provided for investigation activities in each site section. The methodology used in the screening of analytical results generated through this Phase II SI, and the screening values used to identify areas of possible concern, are fully explained in Section 7, Volume I of this report. Other supporting data is presented in the Appendices and can be used to support the information presented earlier.

Sites included in Watershed 6, Willis Pond and Crystal Lake, are depicted in Figure 7-1. Table 7-1 is designed to identify each site included in the watershed by number, name, and ongoing investigation activities.

Table 7-1

WATERSHED 6 SITES

Site Number	Site Name	Current Status
P1	UST Across from Building T223	Site Investigation
P2	Building T267 Fuel Spills	Site Investigation
P3	Building T209 UST	Site Investigation

Source: Ecology and Environment, Inc. 1994.

7.1.1 Watershed Location and Description

Watershed 6 comprises the area draining toward Willis Pond and its associated wetlands including Crystal Lake (Bottomless Pond); the wetlands south of Hudson Road near the main gate; and the wetland it "shares" with Taylor Brook, which is arbitrarily divided at

Patrol Road. The east side of the hill east of the MFFA (which continues northeast to the former Commanding Officer's house) at Site P3 also drains to the wetlands of Watershed 6. Consequently, the sites E & E investigated within this watershed include Sites P1, P2, P3, and the north end of Site P28. Site P28 has been discussed with sites in Watershed 2.

Site P3 is unusual because it is located on top of a hill of till, precisely on the watershed boundary. Because the Willis Pond wetlands are closer and the hydraulic gradient is steeper to the south than it is to the north, it is assumed that both surface water and groundwater discharge from Site P3 into Watershed 6. Sites P1 and P2 at the southern foot of the same hill undoubtedly drain into the wetland both on the surface and underground.

The glacial outwash in this area is assumed to be very similar to that in Watershed 2, as the buried valley of the preglacial Assabet River heads northeast under these wetlands from just east of the main gate. The outwash is expected to be deep, with coarser more permeable material near the ground surface. Because of the very shallow groundwater (less than 15 feet) at the foot of the hill, adjacent to the wetlands, the deeper outwash is probably not involved in contaminant migration from Site P1 and Site P2, but it may be involved in migration from Site P3, if there is any to be found.

Surface water and groundwater discharged from this watershed flow to Willis Pond and then to Run Brook, a tributary of Hop Brook. Water-level measurements were collected at Sites P1, P2, and P3 on 13 September and 3 December 1993. Average groundwater elevations presented in the physical characteristics descriptions of each site were calculated from water-level measurements collected from all wells at a site during both field events. All measurements are presented in Table 7-2 as groundwater elevations.

Table 7-2

WATERSHED 6 — WILLIS POND AND CRYSTAL LAKE GROUNDWATER ELEVATIONS

Site	Well	Water Level*	
		09/13/93	12/03/93
P2	E3-P2-M01	189.57	189.47
P3	E3-P3-M01	223.84	not taken
	E3-P3-M02	207.66	dry

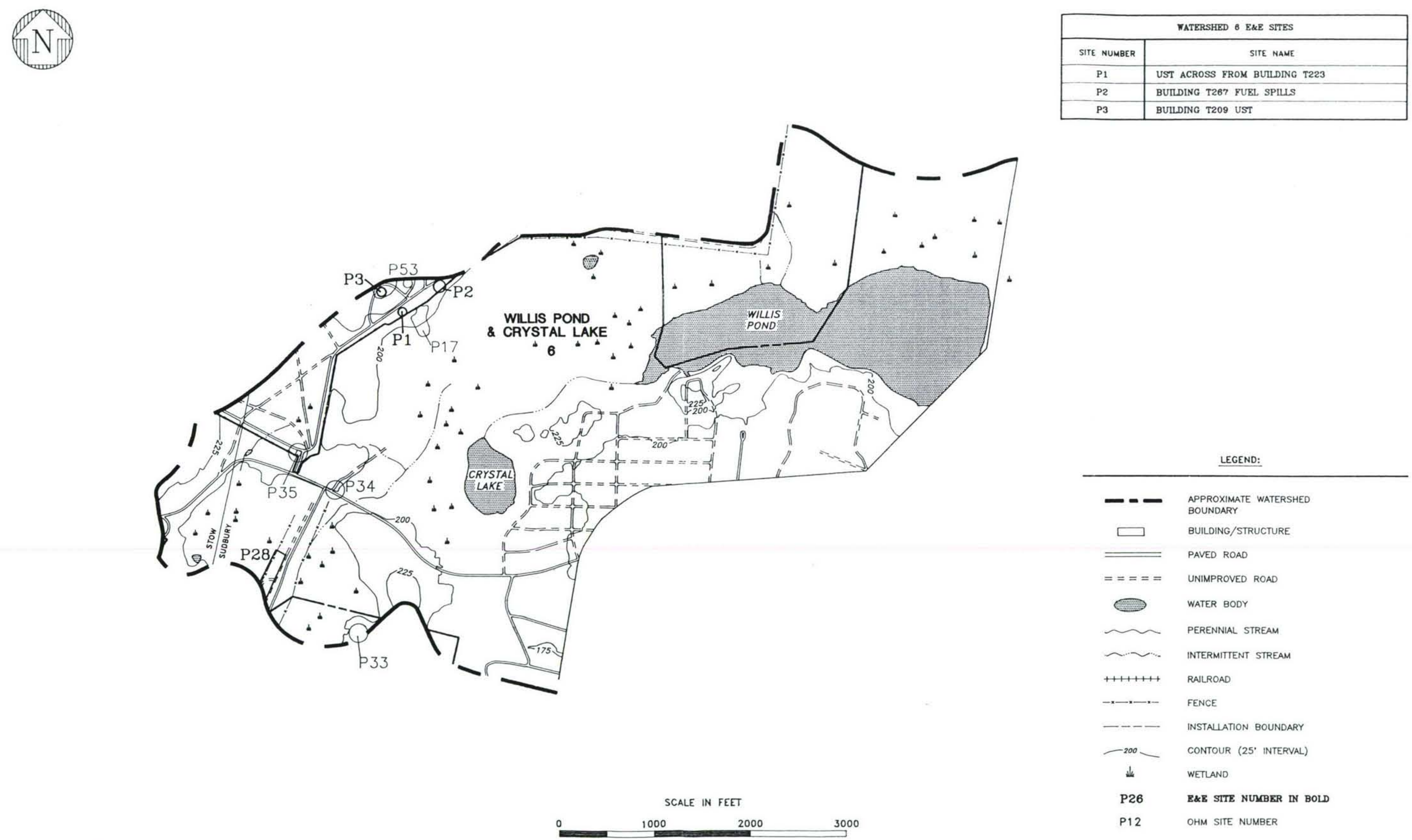
*All measurements are recorded in feet AMSL.

Source: Ecology and Environment, Inc. 1994.

Groundwater elevations could not be calculated from water level measurements at ATEC wells (MW1, MW2 and MW3) because no survey data was available for these wells. Samples and water level measurements were not collected at well OHM-BW-3 as part of the investigation of the watershed.

UC6S038B

WATERSHED 6 E&E SITES	
SITE NUMBER	SITE NAME
P1	UST ACROSS FROM BUILDING T223
P2	BUILDING T267 FUEL SPILLS
P3	BUILDING T209 UST



ecology and environment

Figure 7-1 WATERSHED 6 – WILLIS POND & CRYSTAL LAKE

7.1.2 Preliminary Watershed-Wide Assessment

No watershed wide assessment could be performed because to date the only surface water and sediment samples taken were from Willis Pond or in the immediately surrounding areas. No samples have been collected in drainage pathways from the sites in Watershed 6 that could be used to assess whether any migration of potential contaminants has occurred. Refer to the individual site assessments (Nature and Extent sections) for a discussion of sample results.

7.1.3 QA/QC Program Analysis of Results for Watershed 6

This section provides a summary of the results of the QA/QC review performed using the protocol described in Volume I, Section 5.3.3.

Data for Watershed 6 were evaluated for usability by reviewing laboratory and field QC sample data for contamination possibly introduced into field samples by either sampling or analysis procedures. First, method blanks were reviewed for each analyte in the 121 lots associated with Watershed 6, followed by trip blanks and then rinsate blanks. Following consideration of laboratory and field QC blank samples data, laboratory flagging codes and USAEC data qualifiers were evaluated with laboratory control charts for each lot to assess potential QA/QC problems. Analytical results were then reviewed for precision found accuracy recoveries through consideration of the RPD between each sample/duplicate pair and MS/MSD sample set, and MS/MSD spike recoveries and surrogate recoveries.

A discussion of samples for each study area qualified as part of the QA/QC evaluation. Samples with contamination also found in the blank were qualified either with a "B" usability code for "present in the blank" or a "K" usability code for a result-biased high. Samples considered to have QA/QC problems were qualified with either a "J" usability code for estimated, an "L" usability code for a result-biased low or "R" for rejected. Appendix F provides a list of all QC summary data for method blanks, trip blanks, rinsate blanks, field duplicate samples, and MS/MSD samples.

7.1.3.1 Site P1 — UST Across Road From Building T223

Methylene chloride, sodium, and lead were found in the method blanks or rinsate blanks. The metals were attributed to the standard soil matrices or to the source water used to create the blanks, and methylene chloride was attributed to laboratory contamination. Methylene chloride was the only volatile organic found in the trip blank samples and was considered a common laboratory contaminant. Seven samples were affected and qualified as present due to the blank for methylene chloride and flagged with a "B".

Zinc was also found in the rinsate blanks but it was detected in a sample at above five times the blank level but less than 10 times the blank only in BX010101; therefore, this sample was considered biased high and qualified with a "K".

On review of the laboratory QC samples it was determined that antimony was considered estimated due to a poor spike recovery. The only sample affected was BXP01051 which was flagged with a "J".

7.1.3.2 Site P2 — Building T267 Fuel Spills

Beryllium, sodium, zinc, 2,4,6-tribromophenyl, α-BHC, α-chlordane, α-endosulfan, aldrin, methylene chloride, dieldrin, endosulfan sulfate, heptachlor, and lindane were found in the method blanks. The presence of the metals was attributed to the standard matrices, but the presence of trace levels of pesticides was most likely due to instrument carry over. Methylene chloride was considered a common laboratory contaminant. The parameters detected in the rinsate blanks were: acetone, aluminum, bis-2-ethylhexyl phthalate, cadmium, methylene chloride, heptachlor, sodium, lead, antimony, and zinc. Bis-2-ethylhexyl phthalate, acetone, and methylene chloride were attributed to the laboratory since they are considered common laboratory contaminants, and although heptachlor was not considered a common laboratory contaminant it too was attributed to the laboratory due to instrument carry over. The metals were attributed to either particulates entrained with the rinsate source water from the sampling equipment into the sample containers or to the source water. The only volatile organic found in the trip blanks was methylene chloride. The presence of methylene chloride was attributed to laboratory contamination. Low levels of these compounds were flagged with a "B".

In addition, α-chlordane, α-endosulfan, aluminum, aldrin, dieldrin, endosulfan sulfate, iron, heptachlor, lindane, and zinc were found in some samples at concentrations which were greater than five times the concentration found in either the rinsate or method blank but less than 10 times the rinsate or method blank level. These results were considered biased high and flagged with a "K".

On review of the laboratory QC sample, SXP02011, it was determined that aldrin, arsenic, selenium, and zinc were considered estimated due to low spike recoveries. The low recoveries were most likely caused by matrix interferences biasing the results low.

7.1.3.3 Site P3 — Building T209 UST

For Samples collected prior to April 1994

Methylene chloride and zinc were found in the method blanks; methylene chloride was considered a common laboratory contaminant and zinc was probably from the source water used to prepare the standard matrix. The parameters detected in the rinsate samples were: aluminum, methylene chloride, iron, DDT, antimony, TPHC, and zinc. There were no trip blank issues to discuss for Site P3.

In addition, sodium and zinc were found in samples at concentrations which were greater than five times the concentration found in the rinsate blank but less than 10 times the rinsate level. The samples affected were MFP3012 and MXP3012 for sodium and MXP3021 for zinc. The results for these samples were considered biased high and flagged with a "K".

Antimony was the only parameter exceeding the RPD control limits for the duplicate pair (MDP3011/MXP3011). The RPD was 79.1 percent, indicating poor precision. Antimony also was considered estimated due to a slightly low spike recovery for MXP3012 (59.4 percent). The low recovery was most likely caused by a matrix interference biasing the results low, therefore antimony results exceeding the RMDL were considered estimated and flagged with a "J", if the result exceeded the RMDL.

For April 1994 Samples

No quality control samples were collected. Sample data were qualified based on method blanks and control spike results only. Antimony, beryllium, nickel, vanadium, and zinc were considered estimated in sample MFP3AT2 as they were found in concentrations above the method detection limit and below the RMDL and were flagged with a "J". Beryllium and Thallium were considered estimated in sample MXP3AT2 as they were found in concentrations above the method detection limit but below the RMDL and were flagged with a "J". Arsenic in sample MXP3AT2 was considered biased high as the standard matrix spike results were considerably above the contact limits established by the laboratory and the result was flagged with a "K".

7.2 SITE DESCRIPTIONS AND ASSESSMENTS

7.2.1 Site P1 — UST Across From Building T223

Site P1 was originally identified as an abandoned 1,000-gallon UST across from Building T223 in the east-central part of the Annex (Fort Devens 1990). A map describing the layout of Site P1 is included as Figure 7-2.

7.2.1.1 Site Location

Site P1 is situated on the southeastern side of Patrol Road, approximately 1,600 feet northeast of the main gate of the Annex. Site P1 consists of a former UST location, across the road and southeast of Building T223. Currently, a rectangular asphalt pad covers the area. A 3 inch, metal pipe was found leading south from underneath this asphalt pad to an empty wooden structure located across the barbed wire fence in the adjacent Site P17, to the southeast; these are possibly the remains of an old water supply system.

7.2.1.2 Physical Characteristics

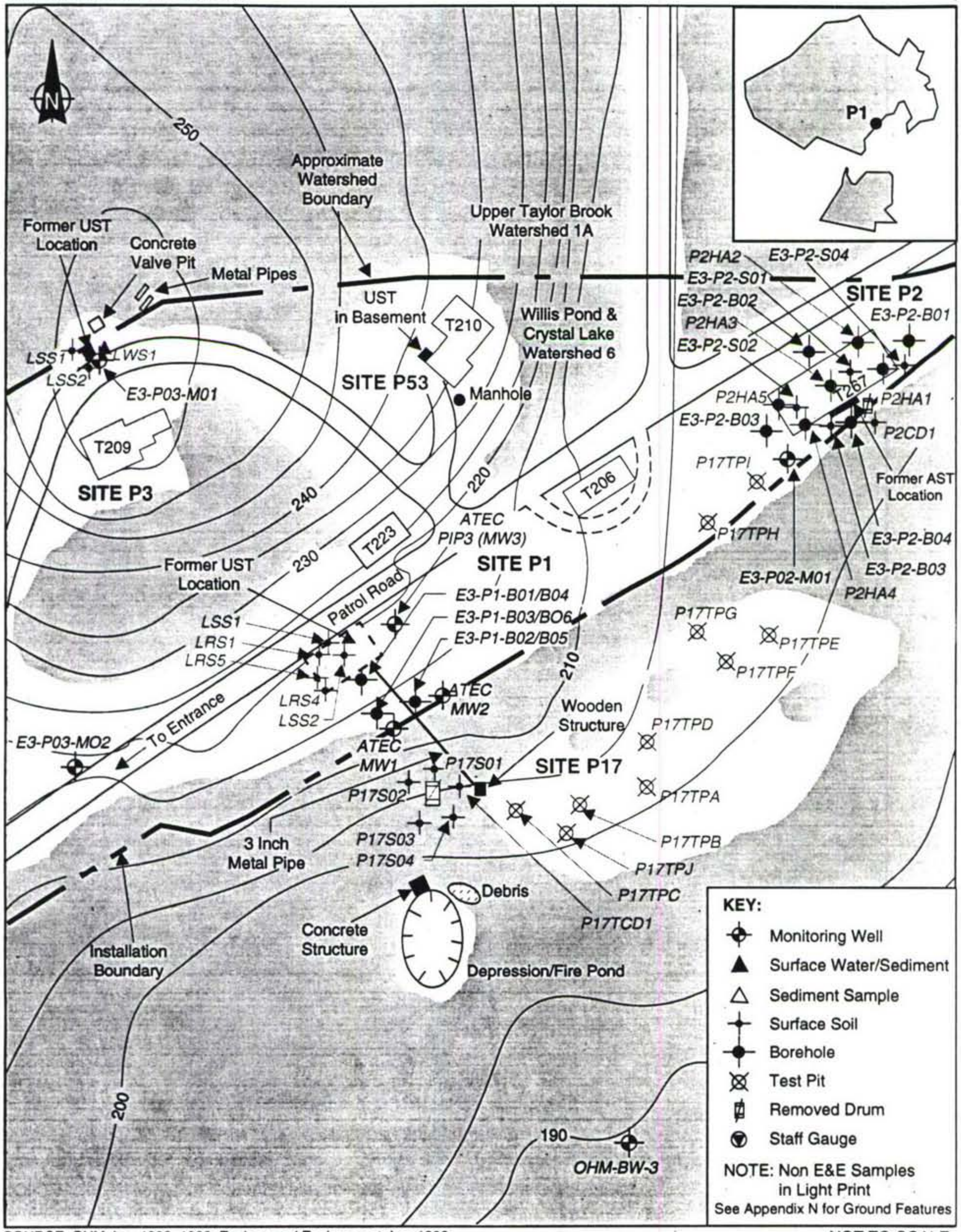
Site P1 lies at the foot of a ground moraine, or hill of glacial till, at an approximate surface elevation of 215 feet AMSL. The average groundwater elevation is approximately 204 feet AMSL. The UST location is underlain by till, but is adjacent to an area of glacial outwash sand and gravel to the southeast, which extends to the wetland surrounding Crystal Lake and Willis Pond.

Boring E3-P1-B01, installed in the vicinity of the former UST location, reached a total depth of 21 feet. Drilling logs from this location indicate that till was encountered throughout the entire length of the boring. A poorly graded, medium-to-coarse sand, gravel, and cobble mixture was observed from the ground surface to a depth of 14.5 feet. A dense, silty clay with little gravel was encountered from 14.5 to 21 feet BGS.

Two additional borings (E3-P1-B02 and E3-P1-B03) were installed downgradient of the UST location, approximately 75 feet southeast of boring E3-P1-B01. The approximate surface elevation in this area is 210 feet AMSL. Data collected from these borings indicate that this portion of the site is underlain by glacial outwash. A very fine-to-medium sand with clay and some gravel was observed to a total drilled depth of 16 feet. Grain size and Atterberg limits analyses were not performed on any samples collected at Site P1. Bedrock was not encountered at any of the Site P1 boring locations and the depth to bedrock is unknown. The underlying formation is projected to be the Marlboro Formation (Hansen 1956).

No hydrogeologic data was collected at Site P1; however, slug tests were performed at one upgradient well (E3-P3-M01), and two downgradient wells (E3-P2-M01 and OHM-BW-3). Calculated transmissivities at each of these wells were extremely low, ranging from 1.65 feet^2 per day at E3-P3-M02 to 90 feet^2 per day at OHM-BW-3. While these numbers do not identify specific transmissivity across the site, they do indicate generally low

11: SUDBURY\NFADD\UC6_P1.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 7-2 MAP OF SITE P1 UST ACROSS ROAD FROM T223

hydraulic conductivity both upgradient of Site P1 in till and downgradient of Site P1 in outwash.

Surface water flows southeast from Site P1 into the nearby wetland and ultimately into either Crystal Lake or Willis Pond. Based on hydrogeologic data and water levels collected at Sites P2 and P3, groundwater flow is also southeast toward Crystal Lake and Willis Pond.

7.2.1.3 Ecological Characterization

Site P1 is the former location of a UST for gasoline, located across Patrol Road and southeast of Building T223. This site is an open area vegetated with low-growing herbaceous plants, including various grasses and forbs. Adjacent to the southern portion of the site is a low density, mixed white pine and oak forest with trees ranging in height from 40 to 60 feet (LFS 1983).

Based on the topography of the local area, it appears that most of the surface runoff from Site P1 would flow in a south-southeast direction. Therefore, a large, broad-leaved, deciduous forested, wetland complex (including Crystal Lake and the western edge of Willis Pond) located approximately 500 feet southeast of the site becomes a potential receptor of contaminants from Site P1 (USDOI 1977).

In general, this area provides several types of habitats including open area, upland forest, forested wetland, and open water. The combination of open areas in association with wooded area is valuable to wildlife because it provides edge habitat and potential travel corridors for many species of wildlife. White pine forests provide nesting and roosting areas for many songbirds and upland game birds, and cover for various species of mammals. The needles, seeds, buds, and twigs from white pine and oak acorns are consumed by many species of wildlife year long (Martin *et al.* 1951). The forested wetlands and the open water southeast of the site provide habitat for nesting and roosting and are a source of food for migratory waterfowl. The open water also provides habitat for various aquatic and semi-aquatic wildlife species such as fish and amphibians.

The wetland complex adjacent to Site P1 has been identified as containing two areas listed as unique habitats; a dwarf shrub bog located on the western edge of the wetland, and an Atlantic white cedar swamp located in the east part of the wetland bordering Willis Pond (Hunt 1992). In addition, a population of beggar-ticks (*Bidus discoidea*), a state Watch-list plant species, has been found in the northwest portion of this wetland complex (Hunt 1992). No unique listed habitats have been identified in the vicinity of the site (NHESP 1992).

7.2.1.4 Site History

Site P1 is the former location of a 1,000-gallon UST for gasoline located across the Patrol Road and southeast of Building T223.

In 1961, a building known as Building T202, located across from Building T223, was demolished. Although there is no confirmatory evidence, it is believed that the UST at Site P1 was associated with this building. A 1959 memorandum (Devens 1959) noted the use of Building T202 as a fire station and motor pool, and a later memorandum (Devens 1961), mentioned that Building T202 was used as a maintenance garage.

There has been significant confusion as to the identity of the building now believed to be Building T223. Before 1967, Building T223 was referred to as T423. It was also identified as Building T225 by ATEC, and this name was used in some of their remediation documents (ATEC 1992). Detailed searches through historical maps and files indicate that Building T223 is most likely to be its correct designation. Building T223 was constructed in 1935 for use as a garage. Currently, it is still intact and stands on the north side of Craven Lane.

7.2.1.5 Results of Previous Investigations

Investigations at P1 through mid-1993 have been fully described in Section 7.10 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). Work at this site has included the removal of a 1,000-gallon UST and is described in ATEC's *Technical Report, Volume 3 — Sudbury, Underground Storage Tanks Closure, USTs No. 0099-101, Buildings 209/409/225 (ATEC 1993)*. Subsequent investigations have aimed at locating or defining the limits of, and characterizing the possible contamination introduced by the UST through confirmatory surface and subsurface soil samples and the installation of wells to monitor groundwater quality.

The geophysical study conducted by Neponset Geophysical Corporation (NGC) in 1991 located the UST. During the survey, the study team found a bent fill pipe emanating a strong petroleum odor. Following ATEC's removal of the UST in 1992, three monitoring wells (MW1, MW2, and MW3) were installed hydrologically downgradient of the former UST location. NDIR readings taken on the soil from the walls of well excavations indicated the presence of TPHC (9.0 ppm to 56.8 ppm). These wells were subsequently sampled and laboratory analytical results did not indicate the presence of TPHC in groundwater.

In 1992, following the ATEC investigation, Fort Devens personnel collected five soil samples downgradient of the area and one surface water and one sediment sample. No VOCs were detected in any of the soil samples or in the surface water sample collected from a small depression/pond located approximately 100 feet south of the excavation. While lead (19 μg/g and 70 μg/g) was detected in the soil samples, it was not detected in the surface water sample. No information providing the exact sample identification number or the sampling location is available; consequently, these samples are not noted on the site map.

Removals

In 1992, the 1,000-gallon UST was removed by ATEC, under contract to and supervision of Fort Devens. Before the removal, residual UST contents were containerized.

Soil within the excavation was visibly contaminated and approximately 150 tons of soil were removed. The tank and associated piping were found to be severely corroded.

A total of eleven soil samples were collected from the excavation. Nine samples were field-screened with an NDIR and indicated the presence of TPHC (4.9 μg/g to 43.5 μg/g). Only samples LSS-1 and LSS-2 were sent for laboratory analysis. Results indicated the presence of TPHC for samples LSS-1 (1,661 ppm) and LSS-2 (56 ppm). Additional post-remedial excavation was conducted to reach background levels (less than 1 ppm) using a PID to field-screen soil samples. Laboratory analysis of post-remedial excavation soil samples indicated TPHC in samples LRS1 (32 ppm), LRS4 (33 ppm), and LRS5 (12 ppm). The excavation was backfilled with sand.

7.2.1.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, were analyzed for TCL organics, TAL metals, and TPHC. A summary of Phase II Sampling Activities at Site P1 is provided in Table 7-3.

Table 7-3

PHASE II SAMPLING EFFORTS FOR P1 — UST ACROSS FROM BUILDING T223

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Subsurface Soils	6	08/06/93 08/13/93	Two samples were collected from each borehole to characterize subsurface contamination, if any.
	6	11/30/93	Three borings were resampled and a total of six samples were collected and analyzed for BNAs and TAL metals.

Source: Ecology and Environment, Inc. 1994.

Subsurface Soil Sampling

E & E collected a total of six subsurface soil samples from three borings completed at Site P1. The first boring, E3-P1-B01, was located in the area where the UST removal was completed. Two samples were taken from the boring at depths of 9 to 11 and 14 to 16 feet BGS. Borings E3-P1-B02 and E3-P1-B03 were completed downgradient of the UST removal area, approximately 10 feet downslope from the foundation, where E3-P1-B01 and the UST were located. Two samples were collected from each boring at the following depths: 4 to 6 feet BGS and 14 to 16 feet BGS from boring E3-P1-B02; and 4 to 6 feet BGS and 9 to 11 feet BGS from boring E3-P1-B03.

As a result of the QA/QC and scheduling problems, E & E recollected six subsurface samples from the borings listed above. These samples, collected during November 1993, were analyzed for TAL metals and BNAs only.

7.2.1.7 Nature and Extent of Contamination

The concern at this site was the possibility that petroleum may have migrated from the former UST location into surrounding media. A summary of detections above preliminary screening levels at the site is presented as Table 7-4. The chemical summary report for the site is included after this site as Table 7-5.

Table 7-4

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P1

Medium (Units)	Compound	Max. Background	Screen Level	Source	Maximum Concentration	Site ID	Frequency Above Screen Level
Subsurface Soils (μg/g)	Beryllium	0.446	0.4	MCP GW-1/S-1[1]	0.506(J)	E3-P1-B01	3/3
SOIL (μg/g)	Arsenic	10	30	MCP GW-1/S-1	150	E3-P1-B05	1/3

[1]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

In September 1993, unfiltered groundwater samples were taken from the ATEC MW-3 well located northeast (and downgradient) of the former UST location. This well was installed as part of the post-remedial investigation of Site P1 and was referred to as MW–3 by ATEC. E & E referred to this well as ATEC–P1P3. Sampling of this well was conducted under the scope of work for Site P3, because of its location downgradient from Site P3, but the results are also mentioned here because the well is also downgradient of the former UST location at Site P1.

Analysis of an unfiltered sample collected in September 1993 indicated the presence of numerous metals at concentrations above screening levels: aluminum, beryllium, cadmium, chromium, iron, lead, manganese, and nickel. Concentrations of metals in the unfiltered sample from this well were often double or greater than those found in the other two wells sampled for Site P3. Aluminum (86,000 μg/L), iron (110,000 μg/L), and manganese (1,400 μg/L) were found above Massachusetts SMCLs, while beryllium (4.59 μg/L, estimated), cadmium (8.25 μg/L), chromium (182 μg/L), lead (50.8 μg/L), and nickel (141 μg/L) were above SDWA MCLs. These concentrations also exceed the MCP GW–3 levels for groundwater not used as drinking water for lead (30 μg/L) and nickel (80 μg/L). No pesticides or VOCs were detected in the groundwater sample. Earlier groundwater samples taken from this well by ATEC in 1992 were only analyzed for TPHC, which was not found at significantly elevated levels. Results from TCLP analysis performed on a sample collected by ATEC from the contents of the former UST only revealed the presence of zinc (15,300 μg/L). TCLP analysis of post-remedial soil samples also collected by ATEC indicated lead (500 μg/L) and zinc (420 μg/L) in the soils at the edge of the remedial excavation area.

The ATEC-P1P3 well was resampled in April 1994, and both filtered and unfiltered samples were analyzed for metals. Analysis of the unfiltered sample indicated similar results to the September 1993 sampling with aluminum, chromium, iron, lead, manganese, and nickel all found above groundwater screening levels. Analysis of the filtered groundwater sample from this well, however, indicated no presence of metals in concentrations above groundwater screening levels. Thus, the metals detections in unfiltered samples at this well are probably due to suspended solids in the samples, and dissolved metals are not present in the groundwater in concentrations above screening levels.

E & E used subsurface soil borings to determine if petroleum-related contamination exists in subsurface soils. Although many metals were found to be above soils background concentrations in the boring at the former UST location (E3-P1-B01), only beryllium exceeded soil screening levels. Beryllium (0.506 μg/g) was detected slightly above the maximum beryllium concentration found in surface soils (0.446 μg/g) and above the most conservative soil regulatory (MCP GW-1/S-1) level of 0.4 μg/g. Still, the concentration for beryllium is well below the MCP GW-3/S-3 soil level of 3 μg/g, and probably reflects naturally occurring concentrations of this metal. Although TPHC was detected in the 9 to 11 foot interval (36.6 μg/g) and in the 14 to 16 foot interval (26.4 μg/g), both concentrations were well below the soil screening level of 1,000 μg/g (MCP GW-1/S-1 soil level). No pesticides were detected in boring E3-P1-B01.

The results for metals at the downgradient borings were similar to results from the boring at the former UST location, with the exception of an elevated arsenic concentration found at a depth of 4 to 6 feet BGS in boring E3-P1-B05. The sample was collected during a resampling effort in November 1993 from a boring placed adjacent to the original boring E3-P1-B02. Arsenic (150 μg/g) was found at a concentration five times the screening values for soils in both residential (GW-1/S-1) and industrial (GW-3/S-3) locales. No other metals were found at concentrations above screening values.

The highest concentrations of DDT and DDE in these borings were found in the 4 to 6 foot interval, but not in the deeper intervals.

The only pesticides found in either boring were DDT and DDE in the 4 to 6 foot interval only. The highest levels of DDT (0.054 μg/g) and DDE (0.039 μg/g) found were below the soil screening levels (MCP GW-1/S-1) of 1 μg/g for DDT and 2 μg/g for DDE. The highest concentration of TPHC for the 4 to 6 foot sampling interval (16.7 μg/g) was found in E3-P1-B02; whereas, the highest TPHC concentration found for the 9 to 11 foot sampling depth (24.3 μg/g) was found in E3-P1-B03.

7.2.1.8 Conclusions and Recommendations

Since the relative concentrations of TPHC in soil found in previous investigations were confirmed to be below the most conservative soil screening levels in this investigation, it appears that the removal of soil following the excavation of the former UST was effective in reducing the residual TPHC concentrations to below levels of concern.

Analysis of the filtered samples from the ATEC-P1P3 well indicates that concentrations of dissolved metals are not present in the groundwater in this well above screening levels. The only residual concern raised by sampling results is the detection of arsenic in one boring sample above soil screening levels. While arsenic was not found in other boring samples, or in the ATEC-P1P3 well, given the detection of arsenic at other sites at the Annex, there may be a need for further action at Site P1. However, given that the history of the site as a UST location does not seem related to the arsenic detection, further action at this site should be considered after the completion of other arsenic studies at the Annex. If specific Annex-related sources for arsenic are identified, then further action may be required at Site P1.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table:7-5
Chemical Summary Report For Subsurface Soils
Site: P01
Units: UGG

Test	Parameter	E3-P01-B01	E3-P01-B01	E3-P01-B02	E3-P01-B02	E3-P01-B03	E3-P01-B03
	Field Sample ID	BX010101	BX010102	BX010201	BX010202	BD010302	BX010301
	Sample Date	08/06/93	08/06/93	08/13/93	08/13/93	08/13/93	08/13/93
	Depth	9.0 ft.	14.0 ft.	0.0 ft.	14.0 ft.	9.0 ft.	4.0 ft.
TAL METAL	Aluminum	8400	10000				
	Antimony	< 0.500	< 0.500				
	Arsenic	3.60	4.27				
	Barium	39.5 !	49.8 !				
	Beryllium	0.418 J@	0.506 J!@				
	Cadmium	0.603 !	0.916 !				
	Calcium	745	1240 !				
	Chromium	18.5 K!	19.0 K!				
	Cobalt	7.67 !	10.4 !				
	Copper	12.7 !	13.5 !				
	Iron	14000 !	15000 !				
	Lead	4.73 B	5.25 B				
	Magnesium	2830 !	3120 !				
	Manganese	170 !	240 !				
	Nickel	11.4 !	15.6 !				
	Potassium	2040 !	2550 !				
	Thallium	0.190 J	0.172 J				
	Vanadium	26.4	26.2				
	Zinc	22.5 K	30.3				
TCL BNA	Bis(2-ethylhexyl)phthalate	< 0.330 R	< 0.330 R	< 0.330	< 0.330 R	< 0.330 R	< 0.330
	C27						0.250
	C36						0.110
	Di-n-octyl phthalate	< 0.330 R	< 0.330 R	< 0.330	< 0.330 R	< 0.330 R	< 0.330
TCL Pest	P,P-DDE	< 0.002	< 0.002	0.041 C	< 0.002	< 0.002	0.054 C
	P,P-DDT	< 0.002	< 0.002	0.028 C	< 0.002	< 0.002	0.039 C
TPHC	Total Petroleum Hydrocarbons	36.6	26.4	16.7 J	< 20.0	23.9	< 20.0

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table:7-5
Chemical Summary Report For Subsurface Soils
Site: P01
Units: UGG

Test	Parameter	E3-P01-B03	E3-P01-B04	E3-P01-B04	E3-P01-B05	E3-P01-B05	E3-P01-B06
	Field Sample ID	BX010302	BXP01041	BXP01042	BXP01051	BXP01052	BXP01061
	Sample Date	08/13/93	11/30/93	11/30/93	11/30/93	11/30/93	11/30/93
	Depth	9.0 ft.	0.0 ft.	0.0 ft.	0.0 ft.	0.0 ft.	0.0 ft.
TAL METAL	Aluminum				9140	10300	10200
	Antimony				1.47 J!	< 0.500 J	< 0.500 J
	Arsenic				150 !@	5.91	7.19
	Barium				29.1 !	57.1 !	47.9 !
	Beryllium				0.481 J!@	0.488 J!@	0.437 J@
	Cadmium				< 0.500	< 0.500	< 0.500
	Calcium				1420 !	1640 !	1310 !
	Chromium				11.0	22.0 !	28.5 !
	Cobalt				4.68	10.3 !	8.94 !
	Copper				9.08	16.6 !	15.3 !
	Iron				9840	18000 !	18000 !
	Lead				16.0	4.21	2.62
	Magnesium				1600	4250 !	4130 !
	Manganese				116 !	174 !	124 !
	Nickel				7.60	18.4 !	13.6 !
	Potassium				560	3520 !	2000 !
	Thallium				< 0.500	< 0.500	< 0.500
	Vanadium				18.0	32.5	32.8
	Zinc				33.3	34.8	30.2
TCL BNA	Bis(2-ethylhexyl)phthalate	< 0.330 R	0.120 J	0.100 J	< 0.330		< 0.330
	C27						
	C36						
	Di-n-octyl phthalate	< 0.330 R	0.036 J	< 0.330	< 0.330		< 0.330
TCL Pest	P,P-DDE	< 0.002					
	P,P-DDT	< 0.002					
TPHC	Total Petroleum Hydrocarbons	24.3					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table:7-5
Chemical Summary Report For Subsurface Soils
Site: P01
Units: UGG

Test	Parameter	E3-P01-B06					
	Field Sample ID	BXP01062					
	Sample Date	11/30/93					
	Depth	0.0 ft.					
TAL METAL	Aluminum	9900					
	Antimony	< 0.500 J					
	Arsenic	6.30					
	Barium	60.0 !					
	Beryllium	0.403 J@					
	Cadmium	< 0.500					
	Calcium	1450 !					
	Chromium	20.6 !					
	Cobalt	8.06 !					
	Copper	17.3 !					
	Iron	16000 !					
	Lead	4.20					
	Magnesium	3720 !					
	Manganese	148 !					
	Nickel	13.8 !					
	Potassium	3090 !					
	Thallium	< 0.500					
	Vanadium	28.6					
	Zinc	34.9					
TCL BNA	Bis(2-ethylhexyl)phthalate						
	C27						
	C36						
	Di-n-octyl phthalate						
TCL Pest	P,P-DDE						
	P,P-DDT						
TPHC	Total Petroleum Hydrocarbons						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

7.2.2 Site P2 — Building T267 Fuel Spills

Site P2, including Building T267, was identified as an area of concern by former Natick employees who recalled seeing several stains on the dirt floor of the building (Fort Devens 1990). The exact location and orientation of the building is shown on Figure 7-3.

7.2.2.1 Site Location

Building T267 is situated in a clearing on the southeastern side of Patrol Road about 2,000 feet northeast of the main gate of the Annex. This building has two large openings on the northern side and is divided inside by wooden posts. The eastern part of the building was used as a storage area and still has metal cables, blocks of wood, tires, and miscellaneous refuse scattered on the dirt floor. There are several dark stains on the ground and a slight odor of petroleum is noticeable. A stone wall runs southeast perpendicular to the rear wall of the building. About 50 feet southeast of Building T267, a fence runs parallel to Patrol Road, behind which is a wooded area.

7.2.2.2 Physical Characteristics

Site P2 is located on a glacial outwash plain of sand and gravel at an approximate surface elevation of 202 feet AMSL. The average groundwater elevation at Site P2 is approximately 190 feet AMSL. Observations and data collected from four borings and a single monitoring well installed at Site P2 indicate that the outwash extends to a depth of at least 19 feet, the maximum drilling depth achieved. The outwash consists of a mostly clean, fine-to-medium sand and silt mixture, with fine sand increasing with depth.

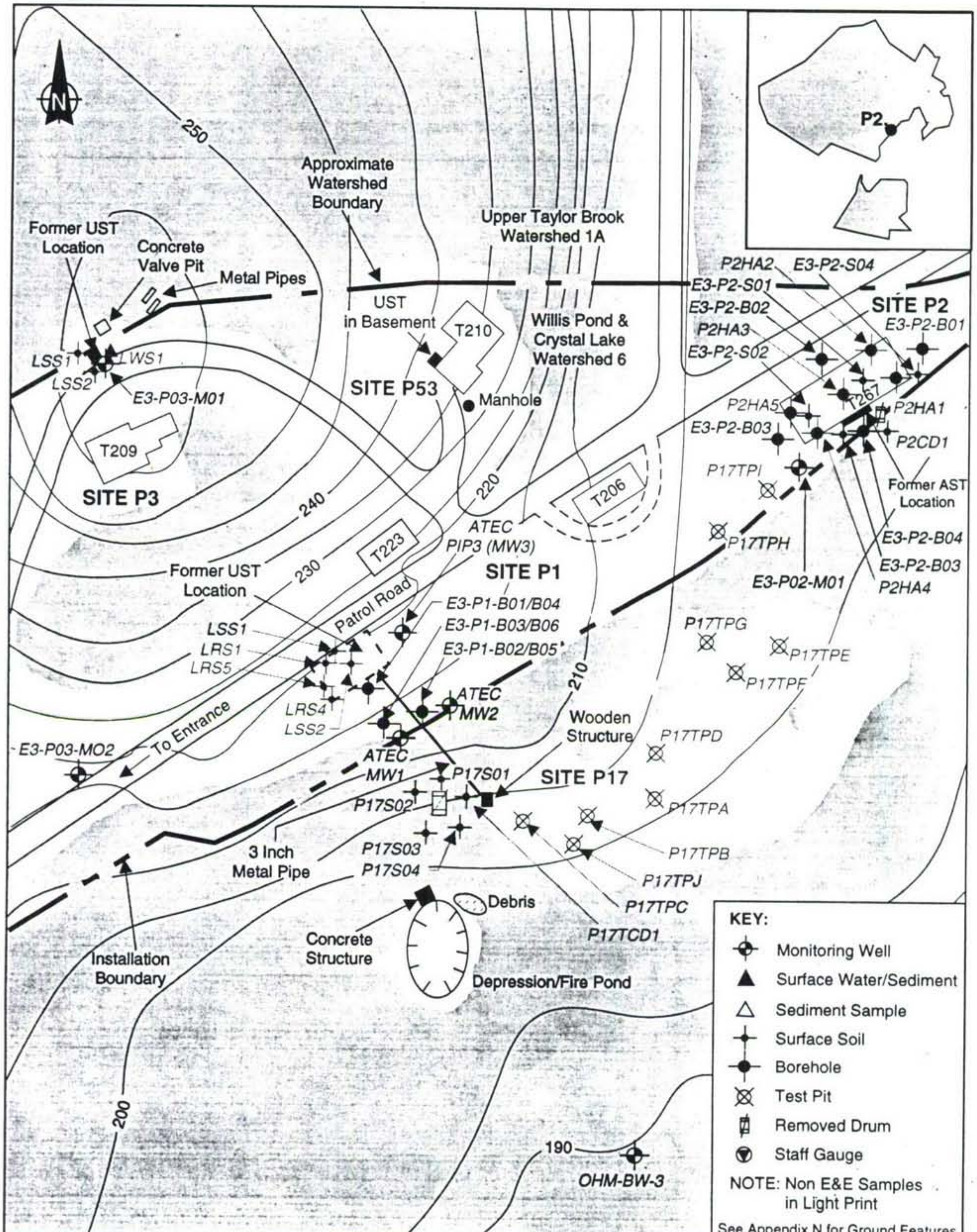
At all boring locations, approximately 15 to 20 percent clay was observed in strata greater than 14 feet BGS. Two soil samples, collected from E3-P2-S01 and the 9 to 11 foot interval of boring E3-P2-M01, which were sent for grain size and Atterberg limits analyses, identified the soil as nonplastic, silty sand. Appendix D contains the complete geotechnical laboratory reports. Bedrock was not encountered during any subsurface explorations and depth to bedrock is unknown but can be assumed to be greater than 21 feet BGS, based on drilling exploration. The underlying formation is projected to be the Marlboro Formation (Hansen 1956).

Monitoring well E3-P2-M01 is located approximately 20 feet south of the southwest corner of Building T267. This well was installed with a screened interval from 8 to 18 feet BGS. A transmissivity of 2.85 feet^2 per day was calculated for E3-P2-M01 with the assumption that aquifer thickness is equal to the length of the water column in the well. The transmissivity was calculated using the following equation:

$$T = Kb$$
$$T = (0.5021)\ (5.680)$$
$$T = 2.85 \text{ feet}^2 \text{ per day}$$

where

11: SUDBURY\UC6_P2.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 7-3 MAP OF SITE P2 BUILDING T267 - FUEL SPILLS

T = Transmissivity ($feet^2$ per day)
K = Hydraulic Conductivity (feet per day)
b = Aquifer thickness (feet)

Appendix G contains complete slug test data and interpretation.

The transmissivity value is small and reflects the very fine sand and silt with clay observed from 8 to 18 feet BGS (the screened interval). Comparable transmissivities of 31.86 $feet^2$ per day, 1.65 $feet^2$ per day, and 90 $feet^2$ per day were observed at nearby wells E3–P3–M01, E3–P3–M02, and OHM–BW–3, respectively.

Surface water flows east and southeast from Site P2 into the adjacent wetland and ultimately into either Crystal Lake or Willis Pond. Based on water levels collected at Sites P2 and P3, groundwater flow is also southeast toward Crystal Lake and Willis Pond.

7.2.2.3 Ecological Characterization

Site P2 includes Building T267, an aluminum clad wood frame building located in an area vegetated with low-growing grasses and forbs. To the south of the building, there is a relatively young low-density forest consisting of white pine and oak trees ranging from 40 to 60 feet in height (LFS 1983).

Based on the local topography, it appears that a forested wetland vegetated with deciduous trees, in the southeast corner of the site, is the main receptor of surface water runoff from Site P2 (USDOI 1983). Refer to Section 7.2.1.3 for a full description of this wetland complex.

Similar to Site P1, this area provides several types of habitats, including open area, upland forest, forested wetland, and open water. The combination of open areas in association with forest is valuable to wildlife because it provides edge habitat and potential travel corridors for many species of wildlife. White pine are favored habitats of many songbirds and upland game birds, which consume the nutritious needles, seeds, buds, and twigs provided in these forests (Martin *et al.* 1951). The forested wetlands and the open water southeast of the site provide a habitat for nesting and roosting areas for many species of songbirds and ground-nesting birds. Furthermore, forested wetlands support many semi-aquatic and aquatic wildlife species. Like forested wetlands, open water provides a habitat for various species of aquatic and semi-aquatic wildlife species such as fish and amphibians, but also supports many species of migratory waterfowl.

The wetland complex associated with Site P1 contains two unique habitats: a dwarf shrub bog located on the western edge of the wetland, and an Atlantic white cedar swamp located in the east part of the wetland bordering Willis Pond (Hunt 1992). In addition, a population of beggar-ticks (*Bidus discoidea*), a state watch-list plant species, has been found in the northwest portion of this wetland complex (Hunt 1992). No unique listed habitats have been identified in the vicinity of the site (NHESP 1992).

7.2.2.4 Site History

Site P2 was identified by Natick Laboratory employees as a building where numerous small spills of oil and one spill of pesticide had occurred (Fort Devens 1990). Property records indicate that the building was used for engineering and maintenance purposes. Specifically, employees recall that a 5-gallon container of the pesticide Malathion was spilled leaving a dark stain on the dirt floor inside the building. To clean up this spill, employees immediately removed soil from surface to a depth of six inches below the visible stain.

Building T267 was built in 1960 to be used for the repair and storage of motor vehicles and engineering equipment. The building was referred to as Building T467 through the late 1960s, when its designation was changed to Building T267.

7.2.2.5 Results of Previous Investigations

Fort Devens cleaned up the 5-gallon spill of Malathion inside Building T267 by removing soil from surface to a depth of six inches below the visible stain (OHM 1994).

OHM conducted a site investigation at Site P2 in 1992. Work performed during this investigation has been described in Section 7.11 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). The site investigation located and characterized contamination resulting from the AST, residuals from the 5-gallon pesticides spill, and contamination from a 55-gallon drum and various stains on the floor of Building T267. Investigations include area reconnaissance, collection of shallow, subsurface soil samples, and removal of both the drum and the AST followed by confirmatory sampling.

At the time of sampling conducted inside the building, OHM employees noted a number of stained areas on the dirt floor. Analysis of the shallow subsurface soil samples indicated the presence of pesticides and PCBs. One sample, in particular, P2HA3, exhibited the highest concentrations of DDT (5.8 μg/g), DDD (3.6 μg/g), DDE (0.177 μg/g), dieldrin (0.021 μg/g), heptachlor (0.013 μg/g), α-chlordane (0.045 μg/g), γ-chlordane (0.056 μg/g), δ-benzenehexachloride (0.28 μg/g), and β-endosulfan (0.009 μg/g) found in any of the samples. PCB 1260 (0.555 μg/g), was found in sample P2HA4 and in the drum confirmation sample (see below). Malathion was not detected in any of the soil samples at Site P2.

Removals

The drum found on the south perimeter of Site P2 contained a tar-like substance. This drum was "overpacked" and staged at Site P13. The drum confirmation sample P2CD1 contained DDT (0.86 μg/g), DDD (0.39 μg/g), and DDE (0.24 μg/g). PCB 1260 (0.353 μg/g) and potassium (1,430 μg/g) were also found above off-site background soil sample concentrations.

The empty AST located behind Building T267 was removed in 1992 by OHM and staged at the temporary storage area at the former MFFA. Samples taken around the AST contained low levels of hydrocarbons and PAHs. One of the AST soil samples, P2CA4, also

had elevated concentrations of DDT (0.384 μg/g), DDD (0.121 μg/g), and DDE (0.103 μg/g).

7.2.2.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigations at Site P2, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, and herbicides on the drinking water standards list. In addition, the subsurface soil samples collected during E3-P2-M01 well installation and the surface soil sample at location E3-P2-S01 were analyzed for TOC, grain size and Atterberg limits. A summary of Phase II Sampling Activities at Site P2 is presented in Table 7-6.

Table 7-6

PHASE II SAMPLING EFFORT FOR SITE P2 — BUILDING T267 FUEL SPILL

Sample Type	Samples	Sample Date	Sampling Rationale
Groundwater	2 from two rounds	08/31/93 12/03/93 01/11/94	Samples were collected from a well located downgradient of the suspected fuel spill area near Building T267 to assess the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	8	08/11/93 08/12/93 12/01/93	Two samples were collected from each of four borings to characterize subsurface soil contamination, if any.
	1	08/12/93	Sample from the screened interval in the well was sent for TOC content analysis.
	1	08/12/93	Geotechnical sample for grain size and Atterberg limits analyses.
Surface Soils	4	09/22/93	Samples were collected from four locations in surface drainage pathways or areas with signs of stressed vegetation or discoloration to characterize surface soil contamination at Site P2.
	1	09/27/93	A sample was sent for TOC analysis.
	1	09/27/93	A geotechnical sample was collected to characterize the nature of surface soil at the site.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

In order to characterize groundwater quality at Site P2 and the potential for off-site contaminant migration, E & E installed one shallow overburden monitoring well, E3-P2-M01. This well is located downgradient of the facility engineer maintenance building (T267), approximately 25 feet southeast of the southeastern corner of the building, and is screened across the water table within the interval of 8 to 18 feet BGS. A total of two rounds of samples (filtered and unfiltered) were collected from the well in September and December 1993.

As a result of a laboratory scheduling error, E & E resampled the well (E3-P2-M01) in January 1994. The samples were analyzed for TCL VOCs only.

Subsurface Soil Sampling

Based on discussion among representatives of the regulatory agencies, USAEC, and the Fort Devens EMO in July 1993, a fourth boring was added to the work initially scheduled in the June 1993, *Draft Technical Plan Addenda* (E & E 1993).

E & E collected a total of eight subsurface soil samples, two samples from each of the four borings completed at the site, to assess the presence, if any, of subsurface soil contamination. All samples were collected from intervals of 9 to 11 feet BGS and 14 to 16 feet BGS, with the exception of the two samples collected from boring E3-P1-B04. Those samples were collected from depths of 4 to 6 feet BGS and 14 to 16 feet BGS.

During monitoring well installation, E & E completed a subsurface sample from the top of the saturated zone and analyzed for TOC content. One sample was also collected from the screened interval in the newly installed monitoring well and sent for grain size and Atterberg limits analyses. The data from this geotechnical sample were used to help assess the physical nature of subsurface soils in the area and their potential effect on rates of contaminant migration.

In December 1993, E & E drilled boring E3-P2-B05, immediately beside E3-P2-B02 to recollect samples which did not meet QA/QC protocols. Samples collected from the 14 to 16 foot depth interval were analyzed for TCL BNAs.

Surface Soil Sampling

E & E collected four surface soil samples from surface drainage pathways and areas with stressed vegetation or obvious discoloration surrounding Building T267. These samples helped characterize the nature of surface soil contamination, if any, surrounding the site. One of the samples, E3-P1-S01, was analyzed for TOC and for grain size and Atterberg limits.

7.2.2.7 Nature and Extent of Contamination

The initial concern at this site was that fuel or pesticides stored inside the building, or from the former AST located at the site or from a drum formerly located at the site, may have resulted in contamination of the surrounding media. Previous and recent sampling results indicated some low-level pesticides and PCBs soil contamination inside the building and in the area immediately around the building. Table 7-7 presents a summary of detections above preliminary screening levels for the site. The chemical summary reports are presented after this site as Tables 7-8, 7-9 and 7-10.

Table 7-7

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P2

Medium (Units)	Compound	Maximum Background	Screen Level	Source	Maximum Concentration	Sample Location ID	Frequency Above Screen Level
GW (μg/L)	Aluminum(U)[1]	--	50	MA SMCL[3]	9,570	E3-P2-M01	1/1
	Aluminum(F)[2]				226	E3-P2-M01	1/1
	Iron(U)	--	300	MA SMCL	14,000	E3-P2-M01	1/1
	Iron(F)				306	E3-P2-M01	1/1
	Manganese(U)	--	50	MA SMCL	304	E3-P2-M01	1/1
	Manganese(F)	--			138	E3-P2-M01	1/1
	Sodium(U)	--	20,000	EPA Health Advisory	25,100	E3-P2-M01	1/1
	Sodium(F)				23,200	E3-P2-M01	1/1
SOIL (μg/g)	Arsenic	10	30	MCP GW-1/S-1[4]	37.0 (estimated)	E3-P2-S03	1/4
	DDT	0.233	2	MCP GW-1/S-1	3.30	E3-P2-S04	1/4
	Aldrin	--	0.03	MCP W-1/S-1	0.040 (estimated)	E3-P2-S03	1/4

[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]MCP GW-1/S-1 = Massachusetts Contingency Plan Soil Category GW-1/S-1.

Source: Ecology and Environment, Inc. 1994.

Analysis of samples from the September 1993 sampling round from the well installed at Site P2 by E & E, E3–P2–M01, indicated the presence of aluminum, iron, and manganese above Massachusetts Secondary MCLs and sodium above the EPA Health Advisory level in both the unfiltered and filtered samples from this well. Analysis of the groundwater results from both September and December 1993 sampling rounds showed that the concentrations of aluminum, iron and manganese significantly decreased in the filtered samples indicating that the elevated levels were most likely due to the presence of suspended solids in the groundwater. The sodium concentrations remained approximately the same, decreasing slightly in the December 1993 analytical results, in both the filtered and unfiltered samples. No other metals were detected at concentrations above screening levels. No pesticides or PCBs were detected in the sample from this well.

Analysis of samples taken from the four subsurface soil borings did not indicate any evidence of subsurface contamination related to Site P2. Several metals, including barium, manganese, and potassium were slightly above surface soil background levels, but were below soil screening levels. DDT (0.009 μg/g) was the only pesticide or PCB detected and was only found in the 14 to 16 foot interval of boring E3–P2–B03. This is of little concern since it is below the MCP GW–1/S–1 soil screening level of 2 μg/g.

No organic compounds, except common laboratory contaminants, were found in any of the subsurface soil samples. The presence of these compounds is attributable to the laboratory environment and is not considered to be site-related contamination.

Although many metals were found to be at concentrations above background levels, only arsenic (37.0 μg/g) was found above the soil screening level of 30 μg/g (MCP GW-1/S-1 and MCP GW-3/S-3) at sample location E3-P2-S03, (located in a runoff path behind Building T267 and the former AST location). Arsenic was not found to be above background levels in any of the other three surface soil samples.

The following pesticides were detected in some of the surface soil samples: DDT, DDD, dieldrin, endosulfan sulfate, β-endosulfan, endrin, heptachlor, heptachlor epoxide, methoxychlor, β-BHC, δ-BHC, and γ-chlordane. Of these compounds, only DDT (3.30 μg/g) was found above the soil screening level of 1 μg/g (MCP GW-1/S-1) at E3-P2-S04. For the pesticides other than DDT and derivatives, many of the detected values were not confirmed or attributable to background contamination. This sample location was chosen because it is in an obvious drainage pathway from inside Building T267. No PCBs were detected in any of the surface soil samples.

7.2.2.8 Conclusions and Recommendations

Although soil samples previously collected by OHM indicated the presence of pesticides (particularly DDT and DDD) and PCBs within the building, at the location of a drum, and in the area around the former AST location, groundwater samples did not indicate any pesticides or PCBs in groundwater at the site. The aluminum, iron, and manganese concentrations found in groundwater samples are likely to reflect naturally occurring levels of these metals. Sodium detected in groundwater sampling could be related to the storage of road salt in this building at one time or possibly to applications of road salt to Craven Lane.

Subsurface soil sampling at this site did not detect any pesticides, except DDT at a very low level in one boring sample, and no PCBs. No detections in subsurface soil sampling were above soil screening values.

Arsenic was detected above soil screening values in one surface soil sample taken immediately south of the building near the former location of the AST. DDT was detected in one soil sample taken immediately northeast of Building T267, in a drainage channel from the interior of the building, at a level above the soil screening value. The DDT concentration in this sample (3.30 μg/g) was below the maximum concentration found in the soil samples taken inside the building of 5.8 μg/g by OHM, indicating that the probable source of the DDT detection is from the inside of the building. The maximum DDT concentration to date at this site was the 5.8 μg/g found inside the building by OHM. This is above the MCP GW-1/S-1 level of 2 μg/g and the EPA Region III RBC for residential soils of 1.9 μg/g, but below the MCP GW-3/S-3 level of 9 μg/g and the EPA Region III RBC for commercial/industrial soils of 8.4 μg/g.

PCBs were detected both inside the building in one sample by OHM and at a drum confirmation sample, but were not detected in E & E groundwater, subsurface soil, or surface soil sampling.

Sampling results suggest that pesticides were probably stored inside Building T267 for use in spraying at the Annex. The source of the PCBs detected by OHM is unknown. PCBs and pesticides in surface soil do not appear to be impacting subsurface soil or groundwater. In addition, concentrations of DDT and its degradation products appear to decline as distance from the building increases, indicating an area of contamination limited to the soil inside the building and the immediate area surrounding the building.

It is recommended that further action be considered at this site, including consideration of a non-CERCLA removal focusing on soil within the building and in the immediate area surrounding the building and the contaminants of concern: pesticides, PCBs, and arsenic.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table:7-8
Chemical Summary Report For Subsurface Soils
Site: P02
Units: UGG

Test	Parameter / Site ID	E3-P02-B01	E3-P02-B01	E3-P02-B02	E3-P02-B02	E3-P02-B03	E3-P02-B03
	Field Sample ID	BX020101	BX020102	BX020201	BX020202	BX020301	BX020302
	Sample Date	08/11/93	08/11/93	08/11/93	08/11/93	08/11/93	08/11/93
	Depth	4.0 ft.	14.0 ft.	4.0 ft.	14.0 ft.	4.0 ft.	14.0 ft.
TAL METAL	Aluminum	5340	5830	4870	5690	4660	5810
	Arsenic	9.73	10.9 !	6.54	8.64	6.21	7.29
	Barium	13.1	28.6 !	13.5	28.1 !	12.7	27.8 !
	Beryllium	0.208 J	0.231 J	0.173 J	0.235 J	0.161 J	0.245 J
	Calcium	771	880	426 J	1940 !	298 J	1400 !
	Chromium	9.64	12.5	11.3	12.2	9.83	13.0
	Cobalt	4.96	5.47	6.09	5.61	5.38	5.70
	Copper	7.41	8.62	7.37	8.52	7.25	8.65
	Iron	7850	9330	8990	9560	8260	9540
	Magnesium	1690	2220	1880	2050	1730	2050
	Manganese	156 !	120 !	170 !	119 !	153 !	133 !
	Nickel	8.86	10.6	11.8 !	9.68	8.82	11.1 !
	Potassium	842 !	1470 !	674 !	1340 !	697 !	1370 !
	Thallium	0.280 J	0.164 J	< 0.500	< 0.500	< 0.500	< 0.500
	Vanadium	9.52	12.9	9.50	13.2	9.54	13.4
	Zinc	16.8 K	26.7	17.0 K	24.8 K	16.3 K	25.1
TCL BNA	C36				0.100		
	Di-n-octyl phthalate	< 0.330	0.052 RJ	< 0.330 L	< 0.330 L	< 0.330 L	< 0.330 L
	Diethyl phthalate	< 0.330	< 0.330 R	0.100 JL	< 0.330 L	< 0.330 L	< 0.330 L
TCL Pest	P,P-DDT	< 0.010	< 0.002	< 0.008	< 0.004	0.009 CL	< 0.004
TOC	Total Organic Carbon						

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: BORE

Table: 7-8
Chemical Summary Report For Subsurface Soils
Site: P02
Units: UGG

	Site ID	E3-P02-B04	E3-P02-B04	E3-P02-B04	E3-P02-B05	E3-P02-M01	
	Field Sample ID	BX020401	BX020402	DX020402	BXP02052	BX0201X1	
	Sample Date	08/12/93	08/12/93	08/12/93	12/01/93	08/12/93	
Test	Parameter Depth	4.0 ft.	9.0 ft.	9.0 ft.	0.0 ft.	14.0 ft.	
TAL METAL	Aluminum	4820	5660				
	Arsenic	7.42	7.96				
	Barium	15.0	28.9 !				
	Beryllium	0.158 J	0.242 J				
	Calcium	425 J	1780 !				
	Chromium	10.8	12.5				
	Cobalt	6.27 !	5.89				
	Copper	7.72	8.94				
	Iron	9020	9270				
	Magnesium	1910	1960				
	Manganese	193 !	128 !				
	Nickel	11.8 !	11.5 !				
	Potassium	740 !	1310 !				
	Thallium	< 0.500	< 0.500				
	Vanadium	9.51	12.8				
	Zinc	29.0	20.2 K				
TCL BNA	C36						
	Di-n-octyl phthalate	< 0.330	< 0.330		< 0.330		
	Diethyl phthalate	< 0.330	< 0.330		< 0.330		
TCL Pest	P,P-DDT	< 0.002	< 0.002				
TOC	Total Organic Carbon					5930	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table:7-9
Chemical Summary Report For Groundwater
Site: P02
Units: UGL

Test	Site ID	E3-P02-M01	E3-P02-M01	E3-P02-M01	E3-P02-M01	E3-P02-M01
	Field Sample ID	MFP02011	MFP02012	MXP02011	MXP02012	MXP02013
	Sample Date	08/31/93	12/03/93	08/31/93	12/03/93	01/11/94
	Parameter .					
TAL METAL	Aluminum	226 K@	17.4 BJ	9570 @	8260 @	
	Arsenic	< 2.00	< 2.00	5.42	8.07	
	Barium	14.1	10.6	79.2	67.2	
	Beryllium	< 5.00	< 5.00	0.566 BJ	0.394 J	
	Cadmium	< 5.00	< 5.00	2.99 J	< 5.00	
	Calcium	5020	3830	6470	5250	
	Chromium	< 10.0	< 10.0	25.3	21.1	
	Cobalt	< 10.0	< 10.0	10.5	8.20 J	
	Copper	< 10.0	< 10.0	12.7	12.9	
	Iron	306 K@	< 25.0	14000 @	14000 @	
	Lead	< 5.00	< 5.00	< 5.00	6.03	
	Magnesium	1120	735	4750	3840	
	Manganese	138 @	100 @	304 @	272 @	
	Nickel	< 10.0	< 10.0	25.1	19.1	
	Potassium	2490	1100	4980	3490	
	Sodium	23200 @	19300	25100 @	18900	
	Vanadium	< 10.0	< 10.0	21.6	22.1	
	Zinc	17.9 BJ	4.10 BJ	52.5 B	83.1	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table:7-10
Chemical Summary Report For Surficial Soils
Site: P02
Units: UGG

	Site ID	E3-P02-S01	E3-P02-S02	E3-P02-S03	E3-P02-S04		
	Field Sample ID	SXP02011	SXP02021	SXP02031	SXP02041		
	Sample Date	09/22/93	09/22/93	09/22/93	09/22/93		
Test	Parameter .						
TAL METAL	Aluminum	5180	6420	8710	5810		
	Arsenic	6.68 J	11.0 J!	37.0 J!@	10.0 J		
	Barium	30.1 !	350 !	20.5	22.4		
	Beryllium	0.164 J	0.305 J	0.320 J	0.227 J		
	Calcium	1700 !	2230 !	360 J	412 J		
	Chromium	15.1 !	26.2 !	19.7 !	17.6 !		
	Cobalt	6.82 !	10.7 !	5.66	6.48 !		
	Copper	11.7 !	190 !	12.5 !	10.8 !		
	Iron	9980	19000 !	10800	9400		
	Lead	13.0	87.0	66.0	44.0		
	Magnesium	2650 !	3120 !	2130	2190		
	Manganese	143 !	323 !	111 !	225 !		
	Nickel	11.7 !	22.9 !	11.0 !	10.8 !		
	Potassium	1800 !	1630 !	954 !	1240 !		
	Selenium	0.195 J	< 0.200 J	< 0.200 J	< 0.200 J		
	Sodium	40000	676	63.9 BJ	73.2 BJ		
	Vanadium	16.1	25.6	18.6	17.6		
	Zinc	67.3 J!	470 J!	33.4 J	33.6 J		
TCL Pest	Aldrin	0.004 KC	0.040 JC@	< 0.002 J	0.000 BJU		
	Dieldrin	0.003 BU	0.024 JU!	0.002 BJU	0.005 KC		
	Endosulfan Sulfate	0.007 KC	0.076 C!	0.004 BU	0.021 U!		
	Endosulfan,A	0.002 BC	0.005 KC	0.001 BJU	0.003 BC		
	Endosulfan,B	0.004 U	0.020 C!	< 0.002	0.006 C!		
	Endrin	< 0.002	0.055 U!	0.008 C	0.014 C!		
	Heptachlor Epoxide	0.001 JC	0.019 C!	< 0.002	< 0.002		
	Methoxychlor	< 0.020	0.019 JC	0.016 JC	< 0.020		
	P,P-DDD	0.015 C	0.055 C	0.120 C!	0.830 C!		

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.

J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.

= Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CSO
Site Type: AREA

Table:7-10
Chemical Summary Report For Surficial Soils
Site: P02
Units: UGG

	Site ID	E3-P02-S01	E3-P02-S02	E3-P02-S03	E3-P02-S04		
	Field Sample ID	SXP02011	SXP02021	SXP02031	SXP02041		
	Sample Date	09/22/93	09/22/93	09/22/93	09/22/93		
Test	Parameter .						
TCL Pest	P,P-DDE	0.004 C	0.025 C	0.091 C	0.034 C		
	P,P-DDT	0.036 C	0.630 C!	0.620 C!	3.30 C!@		
	alpha-BHC	0.002 BJC	0.010 CK!	0.001 BJC	0.001 BJC		
	beta-BHC	< 0.002	0.012 C!	< 0.002	< 0.002		
	delta-BHC	0.003 C	0.016 C!	< 0.002	< 0.002		
	gamma-Chlordane	0.003 C	0.012 C!	0.009 C!	0.005 C		
TCL VOA	2-Butanone	< 0.010	0.019	< 0.010	< 0.010		
TOC	Total Organic Carbon	37800					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

7.2.3 Site P3 — Building T209 UST

Site P3 was identified because of discovery and subsequent removal of an abandoned UST believed to have been used to store heating oil for Building T209 (Fort Devens 1990). A map of P3 is presented on Figure 7-4.

7.2.3.1 Site Description

Building T209 is located about 2,000 feet northeast of the main gate of the Annex and approximately 400 feet north and uphill from Patrol Road. A paved access road diverges northwest from Patrol Road and leads to the front of Building T209. North of the building and immediately across the asphalt road are two parallel metal pipes about 10 feet long and a concrete valve pit.

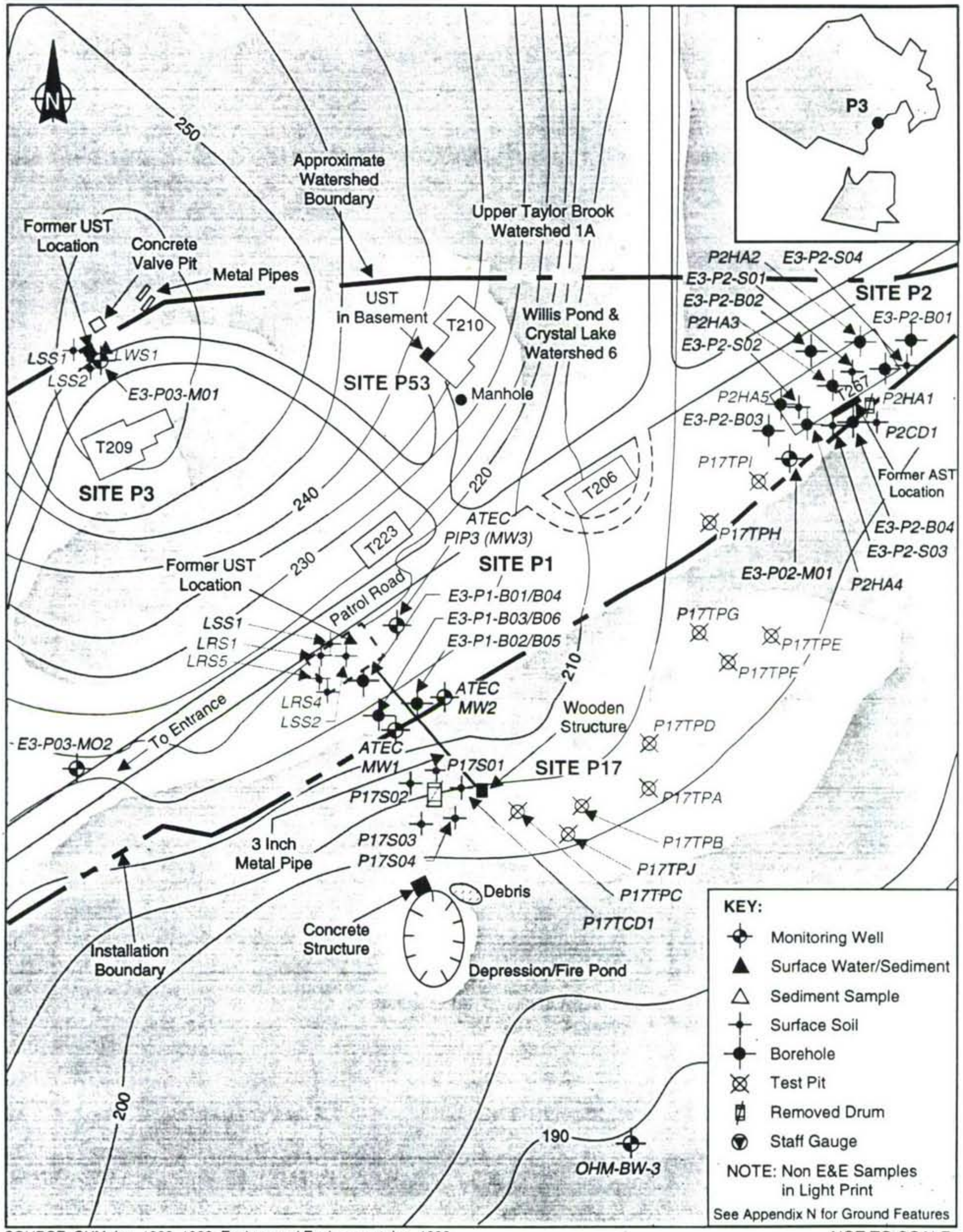
7.2.3.2 Physical Characteristics

Site P3 is located on top of a ground moraine, or hill of glacial till, at an approximate surface elevation of 255 feet AMSL. The average groundwater elevation at Site P3 is approximately 224 feet AMSL. E & E installed two monitoring wells (E3-P3-M01 and E3-P3-M02) at Site P3. Well E3-P3-M01 was drilled at the top of the moraine to a total depth of 50 feet. A hollow stem auger was used to bore a pilot hole at E3-P3-M01, and this boring showed glacial till consisting of a tight sand, silt, clay, and gravel mixture extending to a depth of 18.5 feet. Auger refusal was encountered at 18.5 feet and the hole was abandoned. A second hole was drilled with an air hammer to a depth of 59 feet. As a result of the air hammer drilling, which ejected cuttings from the hole while drilling, a detailed soil classification log could not be generated for the entire depth of the boring; however, drill cuttings indicated that the glacial till continues through the total depth of 59 feet. Well E3-P3-M02 is located at the southwestern base of the moraine, adjacent to Site P1 at an approximate surface elevation of 216 feet AMSL. Drilling at this location extended to a depth of 16 feet BGS. A tight glacial till, similar to that at well E3-P3-M01, extended the entire length of the boring. A soil sample collected from the 9 to 11 foot interval of the borings at well E3-P3-M02 was submitted for grain size and Atterberg limits analyses. The soil was subsequently identified as silty sand with low plasticity. Appendix D contains complete geotechnical laboratory reports.

Bedrock was not encountered at any of the Site P3 boring locations. Depth to bedrock is unknown. The underlying bedrock formation is projected to be the Marlboro Formation (Hansen 1956).

An aquifer transmissivity of 21.86 feet^2 per day was calculated at well E3-P3-M01, on the assumption that aquifer thickness is equal to the length of the water column in the well. The screened interval at this well is from 49 to 59 feet BGS. An aquifer transmissivity of 1.65 feet^2 per day was calculated at well E3-P3-M02, also assuming that the aquifer

11: SUDBURY\NFADD\UC6_P3.CDR



SOURCE: OHM, Inc. 1992, 1993; Ecology and Environment, Inc. 1993

NOT TO SCALE

Figure 7-4 MAP OF SITE P3 BUILDING T209 UST

thickness is equal to the length of the water column in the well. The transmissivities were calculated as follows:

$$T = Kb$$

where

T = Transmissivity (foot^2 per day)
K = Hydraulic conductivity (foot per day)
b = Aquifer thickness (foot)

Well	K	b	T
E3-P3-M01	0.9776	22.36	21.86
E3-P3-M02	0.3234	5.10	1.65

These low transmissivities area a result of the tight glacial till encountered during drilling.

Surface water flows south and southeast from the site toward Site P1 and the adjacent wetland and drains into either Crystal Lake or Willis Pond. Based on water levels collected at Sites P2 and P3, groundwater flow is southeast toward Crystal Lake and Willis Pond.

7.2.3.3 Ecological Characterization

Site P3 consists of a small cleared area, a dirt road, and an abandoned building surrounded by a dense forest vegetated with white pines averaging 60 feet in height (LFS 1983). A thick mat of pine needles covers the ground and the understory is limited to regenerating overstory.

The topography of the area suggests that surface water runoff from the site flows towards a forested wetland located approximately 1,000 feet southeast of Site P3. This seasonally saturated wetland is vegetated with deciduous trees and has previously been described in more detail for Sites P1 and P2.

The main habitat type found in this area consists of upland forest and forested wetland. White pine trees provide nesting and roosting sites for many species of songbirds and upland game birds and serve as valuable cover for a variety of mammal species such as deer and rabbits. Additionally, the needles, buds, seeds, and bark provide food for many wildlife species (Martin *et al.* 1951). The wildlife value of the wetland area has been previously and more fully described in the sections for Sites P1 and P2, and further information can be found there.

Two areas referred to as "unique habitats" by Hunt (1991) have been identified within the wetland area southeast of the site: a dwarf shrub bog and an Atlantic white cedar swamp. In addition, areas of suitable habitat and a population of small beggar-ticks (*Bidus discoidea*), a state watch-list plant species, have been found in the northwest portion of the wetland complex. No unique listed habitats have been identified in the vicinity of Site P3 (NHESP 1992).

7.2.3.4 Site History

Site P3 consists of a 1,000-gallon No. 2 Fuel Oil UST used for storing oil for the General's quarters heater in Building T209. Building T209 appears on a 1944 facility map, as it was converted into a quarters from a structure originally built in 1933. In the 1980s, Building T209 was occasionally used by the Massachusetts State Police for training.

The UST was reportedly abandoned around 1980, and in 1992, ATEC removed the tank and some 120 tons of soil from around the excavation before the excavation was stopped due to depth limitations and obstruction from two trees (ATEC 1992).

7.2.3.5 Results of Previous Investigations

Investigations at Site P3 through mid-1993 have been described in Section 7.12 of the January 1994, *Final Site/Remedial Investigation Report* (OHM 1994). UST closure has been described in *Technical Report, Volume 3—Sudbury, Underground Storage Tanks Closure, USTs No. 0099-101, Buildings 209/409/225* (ATEC 1993). The investigation was conducted at Site P3 primarily to identify and characterize possible UST-related contamination. Site P3 activities have consisted of a geophysical study to locate the UST, UST removal, and confirmatory sampling. Monitoring wells were not installed during the 1992 OHM field investigation due to auger refusal prior to reaching groundwater.

Removals

The UST was located across the road from Building T209 during the geophysical study. Overburden soil was excavated and the 1,000-gallon UST removed by ATEC in 1992 under contract and supervision of Fort Devens. Prior to removal, the tank contents were removed and containerized. The excavation by ATEC at Building 209 (ATEC 1993) was rectangular and was approximately 22 foot by 9 foot and 7 foot deep. The tank was noted to be in good condition, but the associated piping was found to be slightly corroded. The material was shipped to Trimount Bituminous Products for incorporation into asphalt mixes.

Ten soil samples were collected from the UST excavation for PID and NDIR field screening. PID readings ranged from 1.7 ppm to 14.6 ppm total organic vapors. NDIR revealed TPHC (31.3 ppm to 1,795.1 ppm). Two samples were obtained for laboratory analysis for TPHC. LSS-1 revealed TPHC (362 ppm). LSS-2 showed TPHC (427 ppm). Groundwater was encountered within the excavation. Analysis of a water sample (LWS-1) revealed TPHC (44 ppm). Additional soil (approximately 80 tons) was removed until laboratory analysis of soil samples reached levels less than TPHC (100 ppm). Soil borings were also conducted in the excavation in October 1992. PID readings during field screening of soil samples did not detect any petroleum hydrocarbons. Subsequent NDIR screening of the same samples detected TPHC ranging from 9.9 (SB-3) to 328 ppm (SB-2).

7.2.3.6 Field Work Performed

Analytical Parameters

All samples collected during the field investigation, with the exception of the geotechnical samples, were analyzed for TCL organics, TAL metals, TPHC, and herbicides. A boring collected at location E3-P3-M02 was sent for TOC, grain size, and Atterberg limits analyses. Table 7-11 presents a summary of Phase II Sampling Activities at Site P3.

Table 7-11

PHASE II SAMPLING EFFORT FOR SITE P3 — BUILDING T209 UST

Sample Type	Samples	Sample Date(s)	Sampling Rationale
Groundwater	6 from two rounds	08/31/93 09/02/93 09/16/93 12/03/93 4/26/94	Samples were collected to investigate the potential for contaminant migration through the groundwater pathway.
Subsurface Soils	1	08/16/93	Geotechnical sample for grain size and Atterberg limits analyses.
	1	08/16/93	Sample was collected for TOC analysis.

Source: Ecology and Environment, Inc. 1994.

Groundwater Sampling

In order to characterize groundwater quality at Site P3, E & E installed, developed, and sampled two overburden monitoring wells. One well, E3-P3-M01, is a deep overburden well drilled to a depth of 61 feet BGS and screened across an interval from 49 to 59 feet BGS. The well was installed in the center of the former UST area, which lies 15 feet west of the former facility commander's residence (Building T209). Building T209 is located on top of the highest hill found south of Puffer Pond and within the Annex property lines (elevation of over 250 feet AMSL).

The second well (E3-P3-M02) is a shallow overburden well drilled to a depth of 16 feet BGS and screened across the water table in the 7.5 to 15.5 feet BGS interval. The well was installed at the base of the hill, below the former facility commander's residence and downgradient of the UST removal area.

In addition to both newly installed wells, E & E sampled one existing well, labeled ATEC-P1P3, to investigate the nature of contamination in the groundwater pathway. All three wells were sampled during the first round of groundwater sampling in September 1993. Since well E3-P3-M02 was found to be dry in December 1993, only one well (E3-P3-M01)

was sampled during the second round at Site P3. ATEC-P1P3 was resampled in April 1994 to confirm earlier results.

During monitoring well installation at E3-P3-M02, one sample was collected from the saturated zone for grain size and Atterberg limits analyses. Because an air hammer was used to install well E3-P3-M01, no samples could be collected from the saturated zone at this location. These physical analyses provide geotechnical data for the area subsurface material and are used to assess the impact of the subsurface material upon groundwater hydraulic conductivity. The sample from the screened interval in well E3-P3-M02 was also analyzed for TOC.

No sampling activities were originally planned for Site P3. After discussion with the Army, and based on the high levels of TPHC recorded in soil borings, an SI has been conducted at Site P3. The SI was scoped to include well installation downgradient from the former UST site, and groundwater sampling to determine possible groundwater contamination from TPHC.

7.2.3.7 Nature and Extent of Contamination

The concern at this site was that TPHC from the UST formerly located at this site may have leaked into subsurface soil and affected the groundwater. Table 7-12 provides a summary of detections above preliminary screening levels at the site. The chemical summary reports for the site are presented as Tables 7-13 and 7-14 after this site.

Analysis of samples from the newly installed well directly downgradient of the former UST location, E3-P3-M01, indicated aluminum, antimony, cadmium, iron, and manganese above groundwater screening levels in the unfiltered sample and aluminum, antimony, and manganese above screening levels in the filtered sample. The elevated concentrations of metals in the unfiltered sample are likely the result of suspended solids. Cadmium (5.25 μg/L) was found in the unfiltered sample, which is slightly above the SDWA MCL, but was not detected above the reporting limit in the filtered sample. Aluminum and manganese were detected in the filtered sample at concentrations above the Massachusetts SMCLs for both aluminum and manganese of 50 μg/L. Antimony was detected in the filtered sample at 14.6 μg/L, which is above the screening level of 6 μg/L (SDWA MCL), but below the MCP GW-3 level of 300 μg/L for groundwater not used for drinking water. TPHC was not detected above the method detection limit of 210 μg/L in well E3-P3-M01.

Analysis of groundwater samples from the E3-P2-M02 well, located along Patrol Road downgradient and south of the former UST location, indicated aluminum, iron, and manganese in the unfiltered sample, and aluminum (92.6 μg/L) and manganese (76.6 μg/L) in the filtered sample above Massachusetts SMCLs. No other metals were found above screening levels. The aluminum, iron, and manganese levels are probably reflective of naturally occurring levels of these metals at the Annex. TPHC was not detected above the method detection limit of 210 μg/L at this well.

In September 1993, an unfiltered groundwater sample was taken from the ATEC-P1P3 well (which was referred to by ATEC as MW-3, and was installed as part of the post-remedial investigation of Site P1) located downgradient from Site P3 in Site P1.

Table 7-12

DETECTIONS ABOVE PRELIMINARY SCREENING LEVELS AT SITE P3

Medium (Units)	Compound	Maximum Background	Screen Level	Source	Maximum Concentration	Site ID	Frequency above screen level
GW (μg/L)	Aluminum(U)[1] Aluminum(F)[2]	--	50	MA SMCL[3]	86,000	ATEC-P1P3	3/3 0/1
	Antimony(U) Antimony(F)	--	6	SDWA MCL[4]	24.0 5.77	E3-P3-M01 E3-P3-M01	1/3 0/3
	Beryllium(U) Beryllium(F)	--	4	SDWA MCL	4.59 (est.) < 5.00	ATEC-P1P3 E3-P3-M01	1/3 0/3
	Cadmium(U) Cadmium(F)	--	5	SDWA MCL	8.25 < 5.00	ATEC-P1P3 E3-P3-M01	2/3 0/3
	Chromium(U) Chromium(F)	--	100	SDWA MCL	182 < 10.0(K)[6]	ATEC-P1P3 E3-P3-M01	1/3 0/3
	Iron(U) Iron(F)	--	300	MA SMCL	110,000	ATEC-P1P3	3/3 0/1
	Lead(U) Lead(F)	--	15	MA MCL[5]	50.8 < 5.0	ATEC-P1P3 E3-P3-M01	2/3 0/3
	Manganese(U) Manganese(F)	--	50	MA SMCL	1,400 313	ATEC-P1P3 E3-P3-M01	3/3 2/3
	Nickel(U) Nickel(F)	--	100	SDWA MCL	141 < 10.0	ATEC-P1P3 E3-P3-M01	1/3 0/3

[1]U = Unfiltered groundwater sample.
[2]F = Filtered groundwater sample.
[3]MA SMCL = Massachusetts Secondary Maximum Contaminant Level.
[4]SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level.
[5]MA MCL = Massachusetts Maximum Contaminant Level.
[6] Result biased high.

Source: Ecology and Environment, Inc. 1994.

Analysis of this unfiltered sample indicated the presence of numerous metals at concentrations above screening levels, including aluminum, beryllium, cadmium, chromium, iron, lead, manganese, and nickel. The metal concentrations in the unfiltered sample from this well were often twice or more the concentrations in the other two wells sampled in relation to Site P3. Aluminum (86,000 μg/L), iron (110,000 μg/L), and manganese (1400 μg/L) were detected above Massachusetts SMCLs, while beryllium (4.59 μg/L, estimated), cadmium (8.25 μg/L), chromium (182 μg/L), lead (50.8 μg/L), and nickel (141 μg/L) were above SDWA MCLs. Lead and nickel found in the unfiltered sample were also above the MCP GW-3 level for

groundwater not used as drinking water for lead (30 μg/L) and nickel (80 μg/L). TPHC was found below the method detection limit of 210 μg/L. Previous groundwater samples taken from this well by ATEC in 1992 were only analyzed for TPHC, which was not significantly elevated. TCLP analysis of a sample collected by ATEC of the contents of the former UST at Site P1 only detected zinc (15,300 μg/L). TCLP analysis of post-remedial soil samples taken by ATEC indicated lead (500 μg/L) and zinc (610 μg/L) in soils in the UST excavation area and lead (700 μg/L), nickel (120 μg/L), and zinc (420 μg/L) in the soils at the edge of the remedial excavation.

The ATEC-P1P3 well was resampled in April 1994, and both filtered and unfiltered samples were collected and analyzed for metals. Analysis of the unfiltered sample indicated similar results to the September 1993 sampling with aluminum, chromium, iron, lead, manganese, and nickel all found above groundwater screening levels. Analysis of the filtered sample from this well, however, did not indicate concentrations of any metal above groundwater screening levels. Thus, the metals detections in unfiltered samples are probably due to suspended solids, and dissolved metals are not present in the groundwater in concentrations above screening levels.

7.2.3.8 Conclusions and Recommendations

The initial concern at this site was that petroleum hydrocarbons from the former UST may have affected subsurface soil or groundwater. Analysis of one well in the immediate area of the former UST location and two wells further downgradient from the site did not indicate any presence of elevated levels of TPHC or any constituents of heating oil (which was stored in the UST). Elevated levels of metals were detected in unfiltered samples from all three wells, but are likely the result of suspended solids, as indicated by the lower metal concentrations detected in the filtered samples. In the two newly installed wells, E3-P3-M01 and E3-P3-M02, the only metals detected above screening levels in filtered samples were aluminum, antimony, and manganese, all of which are thought to be reflective of naturally occurring levels of these metals. Aluminum and manganese were found in filtered samples from these two wells at levels above the Massachusetts SMCLs, while antimony was found at a level above the SDWA MCL, but below the MCP GW-3 value for groundwater not used for drinking water.

Unfiltered samples from the ATEC-P1P3 well indicated metals at concentrations significantly above the levels in unfiltered samples at the other two wells sampled at this site. Filtered samples taken from this well did not contain elevated concentrations of metals. Thus, it is likely that the metals detections in the unfiltered samples are due to suspended solids and not to dissolved metals.

Given that TPHC or constituents of heating oil were not found in wells at or downgradient from the former UST location at Site P3, and that the metals detected in unfiltered groundwater samples ar the result of suspended solids (and not dissolved metals), there are no concerns raised by sampling results at this site. Thus, no further action is recommended at Site P3.

Table:7-13
Chemical Summary Report For Groundwater
Site: P03
Units: UGL

Test	Site ID	ATEC-P1P3	ATEC-P1P3	ATEC-P1P3	E3-P03-M01	E3-P03-M01	E3-P03-M01
	Field Sample I	MXP03AT1	MFP03AT2	MXP03AT2	MDP03011	MFP03011	MFP03012
	Sample Date	09/02/93	4/26/94	04/26/94	09/16/93	09/16/93	12/03/93
Test	Parameter .						
TAL METAL	Aluminum	86000 @	36.0	54000 @	36000 @	93.5 B@	26.4 B
	Antimony	< 5.00 J	4.46 J	<5.00	24.0 @	5.77 B	2.76 BJ
	Arsenic	49.0	<2.00	23.3 K	19.9	5.03	4.30
	Barium	411	10.8	284	230	8.50 J	11.2
	Beryllium	4.59 J@	0.190 J	2.83 J	1.59 J	< 5.00	< 5.00
	Cadmium	8.25 @	<5.00	<5.00	5.25 @	< 5.00	< 5.00
	Calcium	30700	24800	28900	12500	8550	10100
	Chromium	182 @	<10.0	132 @	72.0 K	< 10.0 K	< 10.0
	Cobalt	75.8	<10.0	44.8	31.3	< 10.0	< 10.0
	Copper	127	<10.0	83.7	56.5	3.05 J	< 10.0
	Iron	110000 K@	26.8	83000 @	45000 @	91.2 B	15.2 BJ
	Lead	50.8 @	<5.00	23.8 @	15.2 @	< 5.00	< 5.00
	Magnesium	33000	9190	27400	16400	3690	3970
	Manganese	1400 @	8.29	836 @	841 @	271 @	313 @
	Nickel	141 @	9.64 J	108 @	62.9	< 10.0	< 10.0
	Potassium	25000	4580	19900	14700	3110	2370
	Silver	<2.00	3.02	<2.00	<2.00	<2.00	<2.00
	Sodium	12300	10100	13000	7840	6930	6760 K
	Thallium	<2.00	<2.00	0.920 J	<2.00	<2.00	<2.00
	Vanadium	204	3.01 J	130	94.2	< 10.0	< 10.0
	Zinc	257	14.0 J	187	261	11.2 BJ	9.94 BJ

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Date: 03/17/94
File Type: CGW
Site Type: WELL

Table:7-13
Chemical Summary Report For Groundwater
Site: P03
Units: UGL

	Site ID	E3-P03-M01	E3-P03-M01	E3-P03-M01	E3-P03-M02	E3-P03-M02	
	Field Sample I	MHP03011	MXP03011	MXP03012	MFP03021	MXP03021	
	Sample Date	09/16/93	09/16/93	12/03/93	08/31/93	08/31/93	
Test	Parameter .						
TAL METAL	Aluminum	74.4 B@	35000 @	37000 @	92.6 B@	28000 @	
	Antimony	14.6 B@	10.4 J@	3.11 J	5.49 B	< 5.00 J	
	Arsenic	5.08	18.7	16.4	< 2.00	12.9	
	Barium	7.64 J	225	219	4.24 J	192	
	Beryllium	< 5.00	1.54 J	1.58 J	< 5.00	1.50 J	
	Cadmium	< 5.00	3.78 J	< 5.00	< 5.00	< 5.00	
	Calcium	8720	12200	14000	2590	6100	
	Chromium	< 10.0 K	72.1 K	71.5	< 10.0	79.4	
	Cobalt	< 10.0	31.6	32.9	< 10.0	27.2	
	Copper	2.93 J	53.0	55.0	< 10.0	36.9	
	Iron	55.6 B	43000 @	52000 @	81.8 B	36000 @	
	Lead	< 5.00	13.1	17.0 @	< 5.00	11.0	
	Magnesium	3680	16100	17100	640	9870	
	Manganese	275 @	831 @	863 @	76.6 @	532 @	
	Nickel	< 10.0	59.7	61.7	< 10.0	69.6	
	Potassium	3010	14500	14100	1080	9660	
	Silver	<2.00	<2.00	<2.00	<2.00	<2.00	
	Sodium	7410	8080	7920 K	9280	11000	
	Thallium	<2.00	<2.00	<2.00	<2.00	<2.00	
	Vanadium	< 10.0	91.4	97.7	< 10.0	68.1	
	Zinc	13.7 BJ	180	125	11.4 BJ	107 K	

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value.
K= Result bias high.
L= Result bias low.
R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

Table:7-14
Chemical Summary Report For Subsurface Soils
Site: P03
Units: UGG

	Site ID	E3-P03-M02					
	Field Sample ID	BX0302X1					
	Sample Date	08/16/93					
Test	Parameter Depth	19.0 ft.					
TOC	Total Organic Carbon	4620					

Source: USAEC IRDMIS Level 3/E & E, 1994 - Codes following values indicate data useability. (see below)

B= Attributable to field or laboratory contamination.
C= Confirmed on second column, U= Unconfirmed.
J= Estimated value. L= Result bias low.
K= Result bias high. R= Result rejected.
# = Exceeds ecological screening value
@= Exceeds human health screening value.
!= Exceeds Background.

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